PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

APRIL 1955

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USE OF SILICONES IN THE PLASTICS INDUSTRY

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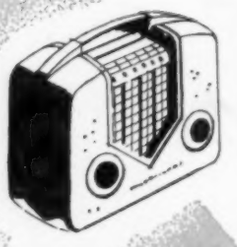

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Letters to the Editor

Dear Sir:

Heartiest congratulations on the birth of PLASTICS TECHNOLOGY! Your expressed editorial policy, as put into actual practice in the very first issue, gives every indication of providing the plastics technician with a valuable all-around source of information.

To further this cause, by all means do not neglect to include articles on new developments, as well as on subjects of general interest in the older and perhaps less glamorous fields, such as the thermosets. Also, to better serve the plastics engineer, have sufficient emphasis on the intricate and minute details of the subjects discussed, rather than give just general and somewhat broad treatments.

Sincere best wishes for long and continued success.

George Baron
Ideal Plastics Corporation
Hollis, New York

• • •

Dear Sir:

Your first edition of PLASTICS TECHNOLOGY was excellent. The articles were both informative and interesting, yet there was not too much to have to digest all in one issue. Most of the trade journals try to cram too much into one issue. The average engineer or executive just does not have the time to read the thick volumes that arrive month after month.

I am looking forward with great interest to the forthcoming issues. Permit me to wish you a most successful future for this magazine. It is a welcome addition to the publication branch of the industry.

D. A. Dearle
Manager, Plastics Division
North & Judd Mfg. Company
New Britain, Connecticut

• • •

Dear Sir:

Congratulations on the excellent start of PLASTICS TECHNOLOGY. Your first two numbers assure a successful future to your publication. The coverage in your excellent feature departments is tops, and takes the place in my opinion of the combined coverage in several other publications.

In connection with one of these departments, Current Market Prices, I am wondering if you would not care to list in the stabilizers section the Harshaw standard vinyl stabilizers. Toward this end, I am taking the liberty of attaching a current price list.

G. M. Juredine, Product Manager
The Harshaw Chemical Company
Cleveland, Ohio

(The more products covered in our price listing, the better. All suppliers are invited to submit quotations on their products for inclusion in our Current Market Prices.—*Ed.*)

• • •

Dear Sir:

We are looking for a material, preferably in sheets about ⅛-inch thick, that will soften and become pliable when immersed in water heated to 150-180° F. The softening may be accomplished either by the heat, the absorption of moisture, or both. The material must become pliable enough to be molded or shaped by hand pressure, and upon cooling or drying should become rigid and strong enough to retain the formed shape when handled.

The material can be plastic, rubber, composition, or other material that will not shrink or warp too greatly in the cooling or drying stage. The material should set reasonably fast (from a few minutes to a few hours).

Can you help us in this matter?

Arthur Dritz
John Dritz & Sons
New York, N. Y.

• • •

Dear Sir:

Thank you and your entire staff for the very fine treatment given to us on the "X-Ray and Fluoroscopic Inspection of Plastic Parts" article in the March issue.

Your interest and cooperation with organizations such as ours in the plastics industry is very much to be desired, and I know that you will find Agile always ready to go out of their way for you.

C. F. Freedman
Vice President-General Manager
American Agile Corporation
Bedford, Ohio

• • •

Dear Sir:

I have reviewed Volume 1, Number 1 of PLASTICS TECHNOLOGY with a great deal of interest, and feel it will be a fine contribution to the field of plastics and plastic elastomers.

T. A. Werkenthin
Head, Elastomer Branch
Materials Development Div.
Bureau of Ships, Navy Dept.
Washington, D. C.

• • •

Dear Sir:

My sincere congratulations on the first two issues of PLASTICS TECHNOLOGY. I feel that your choice of technical articles has been appropriate and of extreme interest. Your various departments, particularly the Patent Digest, the Abstracts of Important Articles, and the various statistical compilations, are especially useful these days.

May I suggest, however, that you give some thought to future articles on applying basic engineering or technological viewpoints to the more efficient management of plastics plants. I have in mind topics such as the reduction of waste factors in plant management, studies of various cost control systems, and articles on the many facets of human and labor relations.

The article by Gordon Thayer on "Precision Control of Injection Molding Pressure" (March issue, page 91) really struck home as we have equipped 50% of the presses in our plant with preplasticizers made by Improved Machinery Co., but each of a different improved design. Their performance in terms of reduced molding strain, better control of dimensional accuracy, and, above all, increased units per hour has in each case exceeded our expectations.

I wonder if other molders using this type of equipment have had similar experiences. If so, sharing these experiences through the medium of a magazine such as yours can help in making machinery manufacturers aware of the problems involved in redesigning their machines to keep abreast of new molding techniques, materials, mold constructions, and demand by the ultimate consumer for better quality molded parts at lower prices.

Harold H. Schwartz
Plastics Division Manager,
Empire Brushes, Inc.
Port Chester, New York

(Comment is invited on the need for "management" articles; if the demand is there, we will try to fill it. Comments on preplasticizers and other machinery developments are also invited.—Ed.)

• • •

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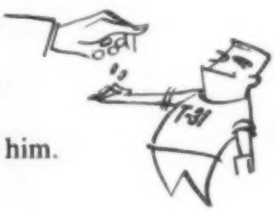

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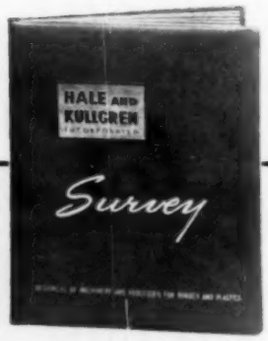

Program for Profits

NEWS in BRIEF

New polyethylene plants keep making news, with two arrivals reported. National Petro-Chemicals opened its new plant at Tuscola, Ill. Using a modified I.C.I. process, the plant has a capacity of 26 million pounds per year. The product, Petrothene, is being sold through U. S. Industrial Chemicals.

Monsanto is in commercial production of Orizon polyethylene at its new Texas City, Tex., plant. The resin is being made by a high-pressure process, but the company is continuing research on low-pressure methods.

On the diisocyanate-polyurethane front, price cuts in its Mondur TD and TDS diisocyanate monomers were announced by Mobay Chemical, whose upcoming plant at New Martinsville, W. Va., is scheduled to start in October.

American Latex Products, a subsidiary of Dayton Rubber Co., will produce 2½ million pounds of polyurethane foams this year. New facilities are being installed at the firm's Hawthorne, Calif., plant that will increase this annual capacity by at least 8 million pounds.

Winners in Koppers' 1955 Design Competition were announced late in March. Aimed at promoting correct design and proper application of plastics in consumer items, the contest was limited to products made of regular or modified styrenes, and attracted 179 entries from 77 molders. Entries were divided into three classifications, and the first-prize winners were Federal Tool Co., Burroughs Mfg. Co., and Injection Plastics Corp. One-year full-tuition scholarships in product design were awarded by Koppers in the winners' names to schools of their choice.

Carbide & Carbon Chemicals broadened its position as a basic supplier of phthalate plasticizers by announcing large-scale production of didecyl phthalate from oxo decyl alcohol at its Texas City, Tex., plant. A general purpose plasticizer with improved permanence properties, the product is said to have the lowest volatility of any commercial phthalate plasticizers.

Expansions announced during the month: Marblette is building a half-million dollar addition at its Long Island City, N. Y., plant. Comprising 15,000 square feet of space, the addition will house the company's research and administrative offices, and be completed by July 1st. Monsanto will double production of Opalon vinyl polymers and copolymers by means of new facilities under construction, and expected to be in operation early next year. A new development lab is being built by Koppers at its Kobuta, Pa., works to evaluate and develop new plastics applications.

New materials this month (see page 179): diisodecyl phthalate and tricresyl phosphate plasticizers; dibutyl fumarate monomer; clear vinyl cast film; a curing agent for epoxies; hydrophobic kaolin; a wetting agent for vinyl plastisols; and a stearate-containing bronze powder.

New equipment of interest (see page 181) includes: domestic and imported injection molding machines; an extrusion cutter; a granulator; an automatic loading board for thermoset molding; a device for converting a compression press to injection or transfer molding; a vacuum forming machine; a small hydraulic press; a dry ice crusher; and a table model universal testing machine.

New products to be noted (see page 184): pressure-sensitive vinyl tape; a nylon fuel tank for miniature plane engines; a plastic engraving stock; a semi-permanent auto garage made of vinyl-coated nylon; fluorocarbon-fiberglass sheets; polyethylene vials with integral caps; printed vinyl display banners; phenolic anti-friction shoes for windows; vinyl-sprayed parade floats; molded butyrate baseball caps; plastic-cased batteries; wood panel doors with vinyl strip hinges; laminated polyethylene pads for auto seat cushions; and vinyl-lined concrete outdoor swimming pools.

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PLASTICS TECHNOLOGY

APRIL, 1955

EDITORIAL: Designing for Plastics

The color and other glamor qualities of plastics, being self-evident from the start, led to initial use of these materials in applications where decorative features were the determining factors. Fortunately, many of these applications were also sound engineeringwise, and helped provide the impetus needed by the young industry.

Unfortunately, however, some of these initial uses were not good engineering. Neither were some of the applications developed as the industry began to spread its wings and look for new fields to conquer. Most of these misapplications arose from insufficient understanding of the materials and their proper use.

The greatest potential for plastics now lies in engineered products for industrial and consumer use. Here, plastics must compete with older materials whose properties are well known and are used in parts designed for these older materials.

•

The accumulation of more engineering data on plastics is only half the battle. Given this data, we must design products for use with plastics. This may seem elementary, but is it?

A study of any product reveals that it is designed for the material from which it is made. Familiarity with the product over the course of years often obscures recognition of this blending of material properties, product requirements, and part design.

When plastics are considered for use in a specific product, the natural tendency is to use them as replacements for the older materials. Sometimes such materials replacement works; more often it does not. We need to design the part for plastics.

•

Plastics design starts with complete knowledge of the material's properties and the product's service requirements. When these correspond, the next step is to consider how the manufacturing and fabricating techniques for the plastic can affect the product's efficiency and costs. Finally, the part should be studied to determine whether it can be redesigned to take fuller advantage of the plastic material.

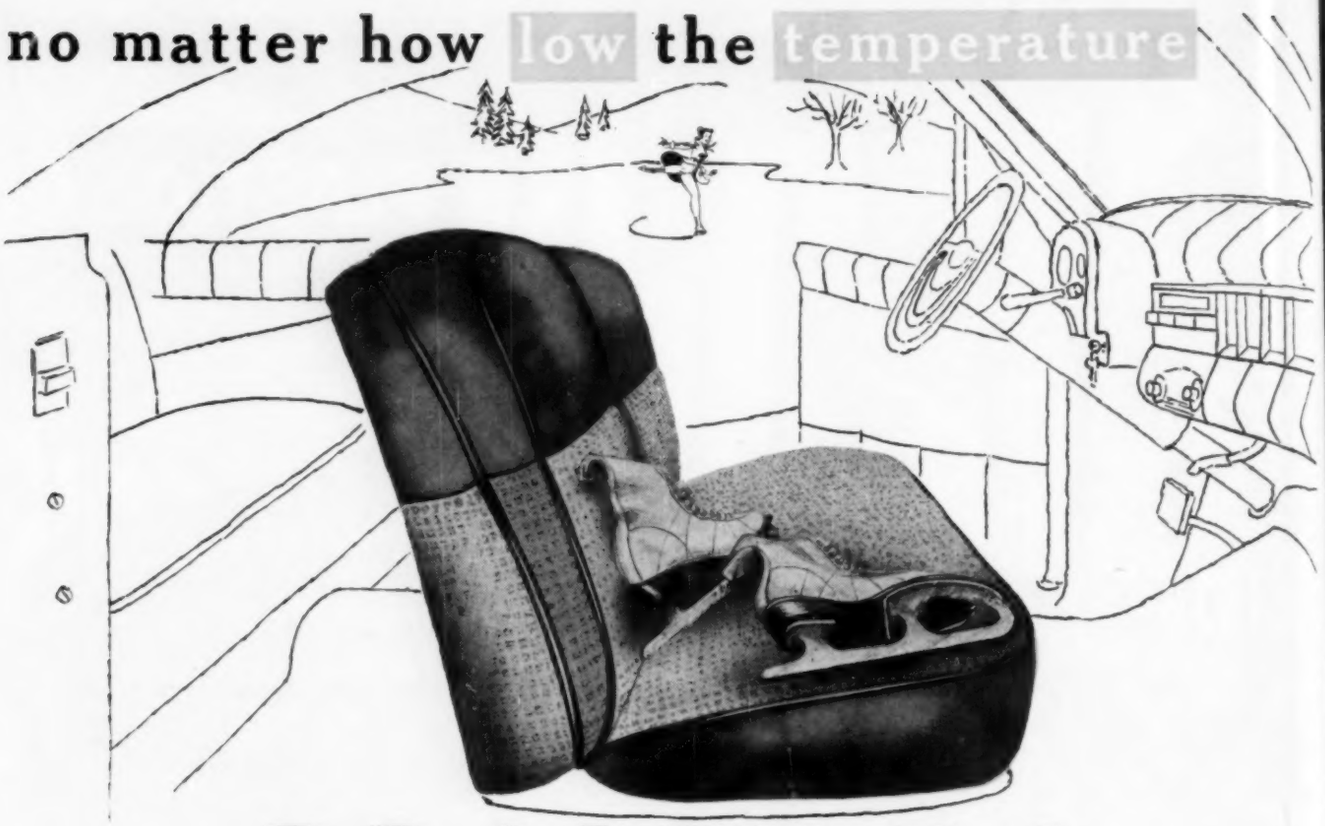
In simplest terms, such redesign can consist of adding reinforcing ribs; using different radii, tapers, and tolerances; or incorporating features to hide parting lines. In the more complex cases, it can mean the design of a new part that looks strange to our eyes, yet is functionally excellent.

Designing for plastics requires education of both the plastics industry and the consuming industries. Perhaps the world of tomorrow will look futuristic and different because its components have been designed for full utilization of plastics.

Arthur M. Merrill

Editor

no matter how low the temperature



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Use of Silicones in the Plastics Industry

Properties and uses of silicone laminating and molding resins, foams, release agents, adhesives, additives, and lubricants.

B. A. THORSBERG, *Technical Representative, and*
L. F. STEBLETON, *Manager of Resin Sales*
Dow Corning Corp., Midland, Mich.

To the chemist, the word silicone is a generic term now used to describe all polymeric substances built on a chain or network of silicon and oxygen atoms, with organic groups attached through carbon to the silicon atoms. Figuratively, silicones are hybrids since they are partly organic and partly inorganic. And, depending on their molecular structure, they can be produced in various physical forms.

To many a design and maintenance engineer, silicones are a new class of materials, available in the form of volatile or viscous fluids, greases and compounds; soft or brittle resins; dielectric varnishes and enamels; and gums or rubbers of many different types. Just as the structure of silicones is unconventional to the chemist, so are their properties unique and unusual to the engineer.

Heat stability, resistance to oxidation and to weathering, incompatibility with many organic materials, chemical inertness, and water repellency are some of the characteristic properties that have made silicones adaptable to so many phases of industry. These properties are the reasons why silicones remain durably serviceable in many applications where other materials fail in a short time.

Use in the Plastics Industry

While there are many fields where silicones offer very definite advantages, their use has not become as widespread in the plastics industry as in some of the other industries. They are not used extensively as plastic materials in making some of the more common, more popular industrial and domestic items, but have been thought of more as specialty items.

Some of the reasons for the slower adoption of silicones as plastic materials are:

(1) Higher initial price.

(2) The need for high temperature fabricating equipment such as ovens and molds.

(3) Changes in production schedules due to different molding and curing cycles.

(4) Certain limitations in the properties of finished parts (such as poor molding quality, and lower impact and tensile strengths).

(5) The need for using reinforcing fabrics, fibers, or fillers. There have been no silicone resins produced to date which are suitable for use in unsupported films, clear castings, or solid (unfilled) high temperature structural parts.

The use of silicone resins in the plastics industry has been growing steadily, if not rapidly. It is recognized that they are not designed to be competitive with many organic resins which function satisfactorily under prevailing operating conditions. Silicone resins supplement organic resins in more severe applications, and span the gap between organic resins and ceramics or metals. In

Bruce Thorsberg received a B.S. in Chemical Engineering from Michigan State College in 1947. Upon joining Dow Corning, he spent 2½ years in the product development department and one year in export sales, then transferred to the New York sales office as a technical representative.

Leo S. Stebleton also attended Michigan State College, taking a bachelor's degree in chemistry. From 1941 to 1944, he worked on saran development with Dow Chemical Co. He joined Dow Corning in 1947 as a member of the resin section in the product engineering laboratories, and transferred to technical sales in 1949.

some types of applications, they are used because they function more effectively than do ceramics or metals.

Some of the resinous silicones which are now being used are described in the following sections, and include laminating resins; molding compounds; and powdered, expandable resin mixes for making rigid foam structures. Also mentioned are silicone resins which can be cold blended with some organic resins to upgrade such properties as heat and moisture resistance, color retention, and resistance to weathering.

Laminating Resins

There are four Dow Corning laminating resins available; two designed primarily for low pressure methods; and the other two for high pressure techniques. The physical and electrical properties of laminates made with these resins are affected to a large extent by the type of reinforcing cloth used.

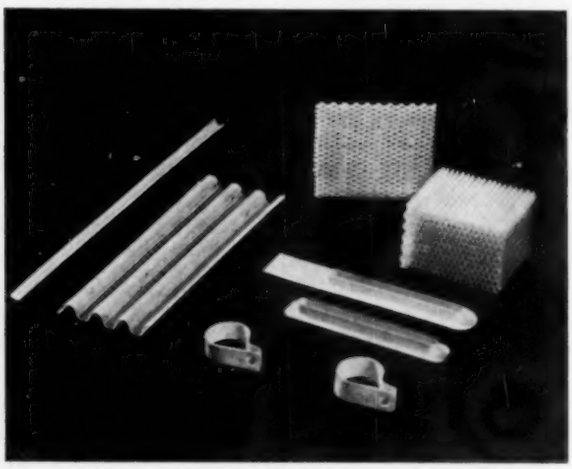


Fig. 1. Typical low pressure laminated parts made of glass fabric bonded with DC 2104 Resin include: (left to right) continuous slot liner; molded slot liner before cutting; clamps; coil forms; and honeycomb core material.

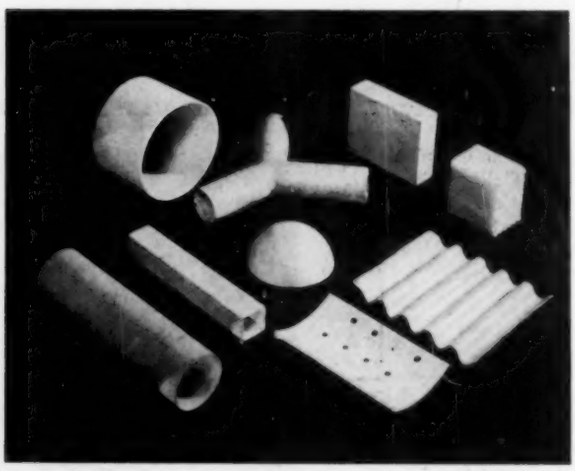


Fig. 2. Typical parts made of glass fabric with DC 2106 Resin by low pressure laminating include mandrel-wrapped, round, and square tubes; Y-shaped duct; heavy section; hemispherical part; corrugation; honeycomb core; and a machined and drilled section to illustrate workability of the laminates.

Low Pressure Resins

The two low pressure laminating materials are Dow Corning 2104 Resin and 2106 Resin. Dow Corning 2104 Resin is ideally suited for laminating simple, irregular, or tubular parts (see Figure 1). Its good flow characteristics at laminating temperatures make it particularly adaptable to vacuum or bag molding techniques, as well as to press molding at pressures from 3-30 psi.

Dow Corning 2106 Resin is a fast curing silicone suitable for laminating at pressures in the range of 30 psi. Laminates of glass cloth, bonded with this resin, show unusual physical strength at both low and high temperatures. Typical parts are shown in Figure 2.

In making low pressure laminates with either of these resins, proper selection of the type of cloth is an important factor in obtaining the physical and electrical properties required. Prior to impregnating, glass cloth should be cleaned of all organic sizing by washing or heat cleaning, while asbestos cloth should be cleaned by heating. A single pass through a solvent solution of the catalyzed resin is usually sufficient to impregnate the cloth. A subsequent pass through a heated, two-zone tower removes the solvent and advances the resin to the desired greenness or flow and gel-time characteristics.

The coated cloth is flexible, virtually tack-free, and with moderate heating can be preformed to practically any shape for molding. The number of plies needed to give the required thickness of laminate can then be posi-

Table 1. Properties of Silicone Glass-Laminates of Type 181 Cloth Bonded with 2104 Resin (After Recommended After-bake).

Tensile strength, psi.:	
At room temperature	30,000-45,000
At 500° F.	22,000-25,000
Compressive strength, psi.:	17,500
At 400° F. after 1/2-hr. at 400° F.	5,400
At 600° F. after 1/2-hr. at 600° F.	4,200
At 800° F. after 1/2-hr. at 800° F.	3,400
At 1,000° F. after 1/2-hr. at 1,000° F.	4,200
Flexural strength, psi.:	25,000-40,000
At 400° F. after 1/2-hr. at 400° F.	14,000-16,000
At 600° F. after 1/2-hr. at 600° F.	12,000-15,000
At 800° F. after 1/2-hr. at 800° F.	11,000-12,000
At 1,000° F. after 1/2-hr. at 1,000° F.	5,000-8,500
Impact strength (flatwise), foot-pounds/inch notch	25
Water absorption, %	0.5-1.0
Specific gravity	1.70-1.85
Dielectric strength, volts/mil	100-200
Arc resistance, seconds	300-350

Table 2. Properties of Silicone-Glass Laminates of Type 181 Cloth Bonded with 2106 Resin (After 48-Hour Cure at 480° F.)

Tensile strength, psi.:	
At room temperature	40,000
At 500° F.	30,000
Compressive strength, psi. (room temperature)	21,000
Flexural strength, psi.:	
At room temperature	50,000
At 500° F.	18,000
Water absorption (after 24-hour immersion), %	0.1
Thermal coefficient of expansion	6.06×10^{-6}
Specific gravity	1.93
Arc resistance, seconds	250
Dielectric strength, volts/mil	100

tioned and molded. Curing of the laminate may be done in a mold or in a circulating hot-air oven.

Tables 1 and 2 list some typical properties of silicone-glass laminates made with these two low-pressure resins. Figure 3 shows how laminates of 181 type cloth bonded with 2106 Resin provide high flexural strength at elevated temperatures.

High Pressure Resins

The two high pressure laminating resins, Dow Corning 2103 Resin and 2105 Resin, are used primarily for electrical applications. Such laminates have excellent heat resistant properties and retain their dielectric characteristics at elevated temperatures.

In general, laminates made with these resins are molded at about 1,000 psi. They are usually flat or tubular in form, and are referred to as GSG laminates. They meet the requirements of Class H insulation rated to withstand a hottest spot temperature of 180° C.

Dow Corning 2103 Resin retains high physical strength in service at elevated temperatures. Properties of laminates made with this resin can vary widely, depending on type of glass cloth, molding technique, and curing cycle.

Dow Corning 2105 Resin exhibits exceptional retention of dielectric properties in service at elevated temperatures. After 5,000 hours at 480° F., for example, test laminates still showed a dielectric strength of 180 volts per mil. Table 3 shows some typical properties of laminates made with two different types of cloth bonded with 2105 Resin.

Table 3. Properties of Silicone-Glass Laminates Bonded with 2105 Resin (After 6-Hr. Cure at 480° F.).

	Made With	
	Type 116 Cloth	Type 181 Cloth
Flexural strength, psi., flatwise		
At room temperature	24,000	43,000
At room temperature aged 100 hrs. at 480° F.	24,400	43,000
At 500° F.	3,300	4,900
At 500° F. aged 100 hrs. at 480° F.	4,600	8,000
Water absorption, % (after 24-hour immersion)	0.05	0.15
Arc resistance, seconds	260	260
Power factor		
At 10^2 cycles	0.015	—
At 10^5 cycles	0.005	—
Dielectric strength, volts/mil		
At room temperature	310	300
After 6 hours at 480° F.	300	—
After 5000 hours at 480° F.	180	—

All four of these silicone laminating resins are also used for bonding mica and powdered iron cores; sealing electrical tubes, Calrod units, and radar antenna leads; as special coatings for barrier tubes; and in other similar applications.

Molding Compounds

A rather recent development, Dow Corning 301 Molding Compound offers many specific advantages over previously available silicone molding compounds.

Dow Corning 301 Molding Compound is a high impact material which is adaptable to either compression, transfer, or semi-transfer molding procedures. Its bulk factor is comparable to that of other high impact molding compounds, and its preformed bulk factor is approximately 3.

Molding pressures are in the range of 1,000-2,000 psi. for compression molding; and 5,000-10,000 psi. for transfer molding. The usual molding cycle is 5-10 minutes at 175° C. In general, the moldings require no after-bake and can be removed from the mold while hot. Mold shrinkage is low (up to 0.0035 inch per inch), and storage life is in the range of three months at room temperature.

Parts molded from Dow Corning 301 Molding Compound exhibit excellent physical properties, and retain high strength at elevated temperatures. They have a flexural strength in the range of 14,000 psi. at room temperature, and 5,000 psi. at 400° F. They have a heat distortion point greater than 500° C., nearly double that of some molding compounds. As molded, Dow Corning 301 Molding Compound has a dielectric strength of 280 volts per mil, a dielectric constant of 3.6, and a dissipation factor of 0.007.

The properties of Dow Corning 301 Molding Compound suggest its use in a variety of applications where

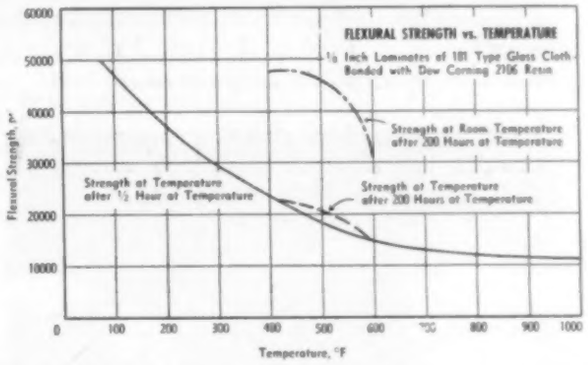


Fig. 3. Effect of temperature on flexural strength of DC 2106 Resin laminates with 181 Type Glass Cloth.

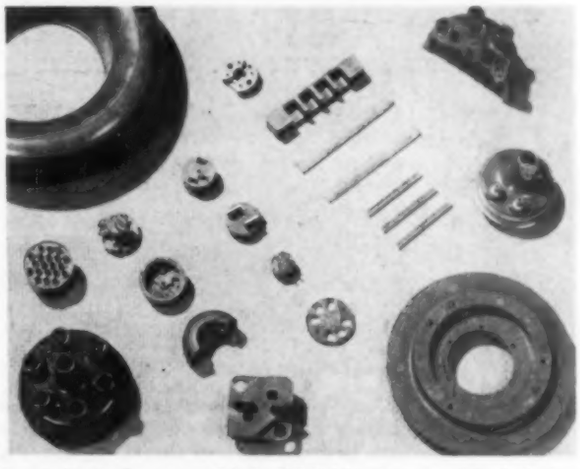


Fig. 4. Typical parts molded of DC 301 Compound include large collector ring insulator; oriented fiber slot wedges; distributor caps; coil top; rotary switch; and miscellaneous connector plugs, terminal blocks, and insulators.

retention of physical or electrical properties is essential (see Figure 4). Such applications include coil forms, slot wedges, terminal boards, connector plugs, switches, and other Class H insulating components, as well as heat-stable structural components for industrial equipment.

Foamed Structures

About two years ago Dow Corning made available two expandable silicone resins which could be used to produce rigid, heat-stable, non-flammable, low density foam structures (see Figure 5).

Of more recent development, are three expandable silicone powders, Dow Corning R-7001, R-7002 and R-7003. These materials, which are based on the earlier foam resins, are supplied completely formulated and ready to use. They require no mixing or addition of blowing agents or catalysts.

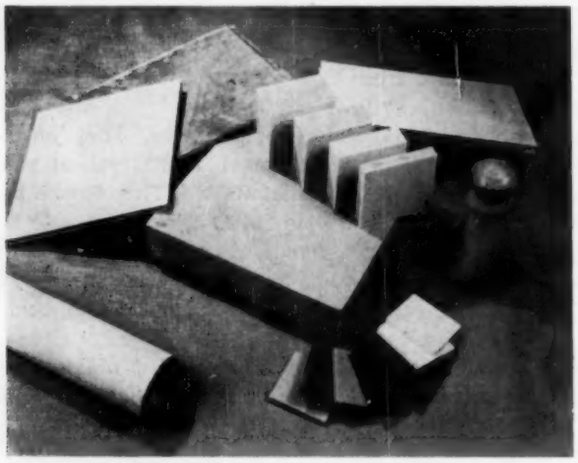


Fig. 5. Silicone foams can be foamed in place, laminated into sandwich constructions, or made up into sheets and blocks.

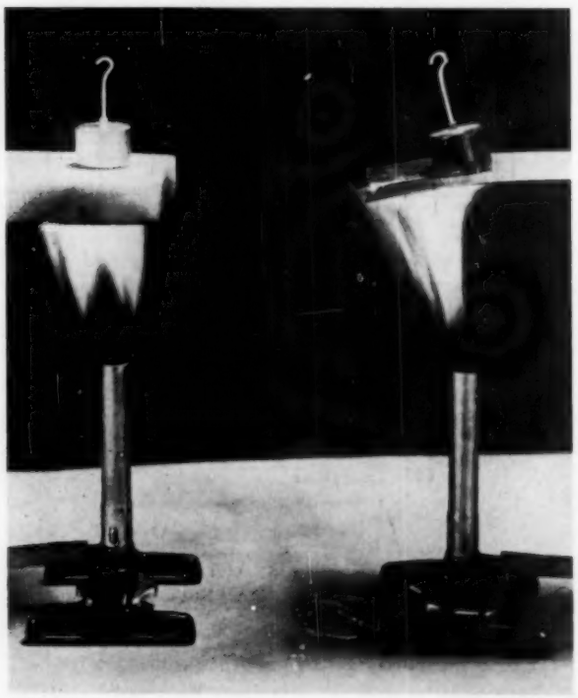


Fig. 6. Lead weights placed onto equal-weight sections of silicone foam (left) and aluminum sheet (right) clamped over Bunsen burners demonstrate the heat stability and thermal insulation of the foam. Although the lower surface blackened, the foam retains its shape and the lead weight is unaffected by the burner flame. The aluminum sheet soon bends under the weight of the lead which, in turn, melts rapidly.

The powders are non-toxic and easy to handle, and can be processed readily under normal humidity and pressure conditions. They produce heat-stable, uniform, multiporous foams with a pore structure predominantly spherical and unicellular. Their heat stability is evidenced by the fact that samples which were subjected to a temperature of 700° F. for over 50 hours, showed only slight structural or surface change.

Foamed structures made from Dow Corning R-7001, R-7002, or R-7003 are exceptionally heat-stable; exhibit good physical and electrical properties; have low moisture absorption; and are good thermal insulators (see Table 4). Figure 6 illustrates the heat stability and thermal insulation of the foams. They can easily be carved or cut to practically any desired shape with conventional woodworking tools.

The unique properties of foamed structures made from these materials suggest their use as light weight electrical, acoustical and thermal insulating sections; firewalls; and buoyant unit components.

Table 4. Properties of Open-Pan Silicone Foams.

	R-7001	R-7002	R-7003
Expension temperature, °F.	320	320	320
Density, lbs./cu. ft.	12	14	16
Max. cell diameter, in.	0.08	0.08	0.08
Compressive strength, psi..			
At 77° F.	100	200	325
After 200 hrs. at 500° F.	100	190	210
At 500° F., after ½ hr.	5	25	70
After 200 hrs.	20	45	80
Weight loss, %			
During expansion	1.2	1.3	1.0
After 1,000 hrs. at 500° F.	3.5	2.6	2.6
At 570° F.	8.0	4.2	4.2
After 72 hrs. at 700° F.	8.5	5.2	5.2
Water absorption after 24-hr. immersion, % by wt.	3.2	2.3	2.1
Heat distortion temperature, °F.	700	700	700
Flame resistance	— Non-flammable —		
Dielectric constant at 10^5 cycles	1.23	1.25	1.26
Power factor at 10^5 cycles	0.0004	0.00102	0.00105
Thermal conductivity, BTU/hr./sq. ft./°F./inch thickness	0.3	0.3	0.3

Other Silicones

Included among the silicone products which are of interest to the molder and plastic fabricator, are release agents, adhesives, additives and anti-seize lubricants.

Release Agents

Silicone release agents are available in several different types and forms. Different fabricating techniques, numerous types of plastics, and the use of varied and intricate moldings are some of the factors that have made it necessary to develop various types and physical forms of silicone release agents.

Among the more commonly used silicone release agents is Dow Corning Mold Release Fluid. It is inert and non-volatile material with a minimum flash point of

575° F., and is supplied at a viscosity of 200-500 centistokes. It does not break down to form a carbonaceous deposit. It provides excellent release, imparts a high finish to the molded piece, and reduces mold maintenance to a minimum.

In general, the fluid is applied as a solvent solution, diluted to the most effective concentration for the particular application. This solvent solution can be applied by spraying, brushing, or wiping with an impregnated cloth or swab. It is also used full strength in some instances, and applied by brushing, swabbing, or metering.

In some spray applications, it may be desirable to apply Dow Corning Mold Release Fluid from handy, easy to use, aerosol spray dispenser packages. Such commercially available units have been found to be efficient and effective for many unit molding operations.

Another form of silicone release agent, Slipicone, has a grease-like consistency and is non-melting. It may be applied by wiping or rubbing, or may be dispersed in solvent and applied by spraying or brushing.

Slipicone is an effective break-in mold lubricant for new or freshly cleaned molds, and has proved effective in molding diallyl phthalate laminates, polyethylene containers, and polystyrene parts. It also gives good release in laminating or casting polyester resins, and in molding polyvinyl chloride in gypsum molds.

A third form of silicone release agent, Dow Corning 20, is a solvent solution containing 50% silicone solids. It forms a semi-permanent, heat-stable, parting film which provides good release and keeps mold build-up to a minimum. One application gives several releases in molding polyacrylate, epoxy, melamine, phenolic and polyester resins.

This material is also an effective release agent for silicone-glass laminates and tubing. For convenience and economy of dilution, this material is also available in the form of a water-dilutable emulsion, containing 25% silicone.

Adhesives

Silicone adhesives are unique in that their adhesive characteristics are so contrary to the reputation that many silicones have established as release agents and "adhesives." Dow Corning C-269 and C-271 are pressure sensitive materials which remain pliable and retain their adhesive strengths even after long exposure to temperatures ranging from 55 to +250° C. They provide good adhesion to such materials as metals, glass, paper, fabrics, and plastics, including polyethylene and polyester films. They adhere well to such "adhesive" materials as silicone rubber, treated paper, and glass laminates or cloth; and to fluorothene plastics.

Designed primarily for producing pressure-sensitive tapes and cloth, Dow Corning C-269 and C-271 are also used to adhere a variety of materials to industrial parts or components. In addition to their excellent thermal stability, these adhesives possess excellent dielectric properties, and good resistance to moisture, weathering, and aging.

Resin Vehicles for Castings

Silicone resin vehicles for protective coatings are another group of silicone products closely related to the plastics industry, and include both "straight" and modified silicones. These resins are used to formulate paints and enamels that are durably resistant to heat, oxidation, weathering, and corrosive gases. Some are colo blended with organic resins to upgrade the properties of the finish.

Resin Additives

Similarly, some silicone resins may be blended with certain organic plastics. As additives, they improve the scuff resistance of polystyrene and its adhesion to glass; prevent the hazing of polyester films often caused by contact with water; and prevent cratering and give improved flow-out and wetting to epoxy, phenolic, and alkyd resins. They also improve the moisture resistance of phenolic-base cements.

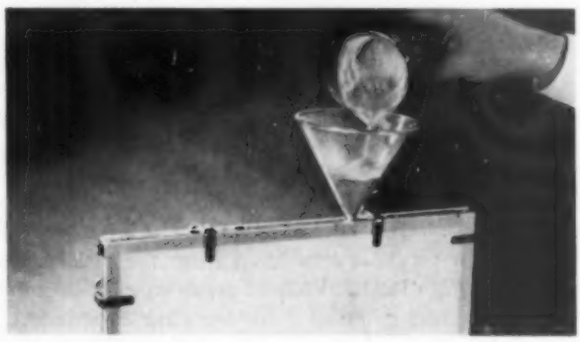


Fig. 7. Foaming in place does not require heavy metal side panels to maintain dimensions.

Greases and Anti-Seize Agents

A silicone grease, Dow Corning 41 Grease, is a heat-stable lubricant for oven conveyor bearings, and has also proved to be an effective anti-seize compound for hold-down bolts, injection nozzles, and other threaded units on high temperature molding equipment. It substantially reduces the time and effort required to dismantle such units, minimizes down-time, and reduces maintenance costs.

Future of Silicones in Plastics

Only 11 years have elapsed since the introduction of the first commercially available silicones. In that short span, the increase in number of uses of these materials has been phenomenal. New and improved silicone products are introduced regularly; shortcomings are being eliminated; and, in conjunction with customer requirements, new applications and new techniques are constantly being developed.

This development work, coupled with the unusual and unique characteristics of the materials, forecasts even more extensive use of silicones to make more heat-stable, more durable plastic items for every-day use in industry, domestic applications, and military uses. These are the reasons why progressive design and maintenance engineers keep posted on silicones, and are using them to produce more marketable, more reliable products and reduce maintenance and production costs.

—The End

Guest Editorial

ROBERT K. MUELLER, *Vice President & Plastics Division General Manager, Monsanto Chemical Company, Springfield, Mass.*

Plastics – The Cosmopolitan Industry

The plastics industry is well on its way to proving it doesn't need a full-blown economy to get ahead in the world. In fact, it is taking root successfully in many areas around the globe where some of our grown-up industries have yet to find a foothold.

We have a great deal to learn from the plastics industry in foreign lands. While in many cases it is going through the same growing pains we have experienced, it is uninhibited by the orthodoxy and environment of the American mass production and distribution system. As a result, it is able to display a certain *savoir faire* about its adolescent status. In a certain Latin American country, for example, it is not uncommon to have to shoo chickens off the molding machines when the factory starts up in the morning. And, in the Rheims district of France, a misapplication would invariably be tied in somehow with the use of plastic stoppers for champagne bottles.

Plastic products seem able to find their niche in complex foreign commercial economies with remarkable ease. And because of this ready acceptance, and because of its flexibility and independency, the plastics industry can furnish raw materials to mold better international relations through the business medium. We have plenty of production know-how to trade, and we can stand to learn more craftsmanship, marketing practices, competitive strategy, and ingenuity from our overseas neighbors.

As might be expected, the most fertile foreign markets are those having the soundest fiscal policies at the moment. Of all the European countries, the easiest for American exporters to do business in are probably Switzerland, Belgium, Denmark, Luxembourg, Holland, Italy, and West Germany, in that order, since all of them have dollars of one kind or another.

Switzerland, West Germany, and Belgium are the "spoiled" hard-currency markets. Everyone seeks to sell in them, which makes the customers extremely critical of quality, service and price. They are useful places, however, in which to test one's competitive spirit.

Holland's commercial environment is fluid in more ways than one. She has some dollar funds available, not only for her own needs but—especially if there is a profit in it for the Netherlands Bank—for the needs of others in the form of "switch" dollars that draw a 10% premium on the money market.

Italy, too, finds dollars; how, no one really seems to know. Italian industry, eager to trade internationally, has grown tremendously since 1935. This is particularly true in chemicals and plastics, a fact well known to some of the world's oldest suppliers who are being challenged by aggressive companies in Northern Italy. Spain and Yugoslavia are flexing their industrial muscles, which will result in opportunities for plastics.

Germany has also made a remarkable recovery, mainly with the help of the United States and Britain. On a world basis, it is once again climbing the rungs as a vigorous exporter, and international political decisions are helping to further this trend. In German industry, competition is just as keen, service just as good, and quality just as high as it ever was.

The United Kingdom has many of the problems that apply to most European countries, in addition to some that are peculiarly British. The treasury keeps a tight hold on the purse strings, hoping one day to pull the elusive grand coup of achieving complete convertibility. Britain's position in plastics, however, is healthily diversified as indcated by her dominant patent situation in polyethylene, and the licensing of half a dozen American companies to use either British patents and/or processes during the past year.

On this side of the Atlantic, there is Canada which has enough of everything, it seems, except people and the markets people make. Most plastics made in the States, however, are now also produced in Canada, and their future—backed by the country's tremendous wealth of natural resources—seems rosy, indeed.

South of the border lie the Spanish-speaking countries where, among other things, there is a toast that goes: *"Salud, pesetas, amor, y tiempo para gustarlos"*—which

(Continued on page 164)

Automatic Deflashing of Thermoset Moldings by Soft-Grit Pellets

Pellet deflashing machines provide significant savings in finishing costs, both in time and labor.

EUGENE F. ANDERSON, *Special Engineer*
American Wheelabrator & Equipment Corp., Mishawaka, Ind.

Progress continues to be made in the art of deflashing molded plastics mechanically and automatically by soft grit pellets. The newest development is the adaptation of pellet deflashing to the defuzzing and deburring of laminated plastics. Pellet deflashing as applied to thermoset moldings has been used successfully by scores of plants for several years.

Although automatic methods are expected to speed deflashing rates and reduce costs, it seems hard to believe that a single process could result in savings of approximately $100,000 per year for a single company. Some firms, however, are experiencing those very savings in time and labor by the use of pellet deflashing.

Cost reductions are achieved in three ways:

(1) Work is deflashed in very large quantities.

(2) Each large quantity is deflashed in just a few minutes. Intricate crevices, metal inserts, and irregular sections can be deflashed since provision is made for the blast of pellets to reach all plastic surfaces.

(3) Many man-hours of manual labor are eliminated and a more thorough job of deburring or deflashing is attained.

The Deflashing Process

This mechanical deflashing process consists of hurling non-abrading pellets upon the moldings which are enclosed in a cabinet-type machine. The process is adaptable to parts in a wide range of sizes. The pellets are thrown by controlled centrifugal force from a rotating bladed wheel mounted within the machine. Mechanized conveyors of various types are used to move the parts in the blast stream so that the deflashing action is exerted uniformly on all areas of the parts. After striking the work, the pellets fall into a hopper for automatic reclamation and reuse. The pellets are cleaned before being recycled to the rotating wheel.

The centrifugal force imparted by the wheel is the only propellant required and no compressed air is ever needed. The throwing velocity of the wheel is the resultant of radial and tangential forces, and has a magnitude of several thousand feet per minute. The energy imparted to the pellets breaks off the flash and burrs by impact. If the flash is brittle enough to be snapped off under a mechanical force, and flash thickness is kept under certain limits by proper mold maintenance, parts of even complex design can be deflashed completely.

The pellets are made of such materials as crushed apricot pits, crushed nut shells, or mixtures of the two. These materials have been found to give the best results because they have enough mass to be propelled with sufficient energy to break off the flash or burr but, except in isolated cases, are not massive enough to scratch, nick, or break the parts themselves. Parts with metal inserts can be deflashed without damage to plated or other highly finished surfaces on the inserts.

The isolated cases mentioned above where parts might be broken by the pellet stream involved parts with extremely thin sections. It must be realized that the pellet shower is not selective in its intensity. Control of the process is limited to the ability of the pellets to remove material sections that are thinner than a given size. If a section of the piece is thinner than the flash, it too, will be knocked out by the pellets.

The heaviest flash that can be removed by this process is usually about 0.008-inch thick. In designing the part care should be taken to eliminate any excessively thin sections, and mold maintenance should be rigorous to avoid heavy flash.

In the very early developmental stages of the process chipping of the parts during deflashing was frequently encountered. This problem has now been virtually eliminated, although the possibility of chipping should always be considered with urea moldings.

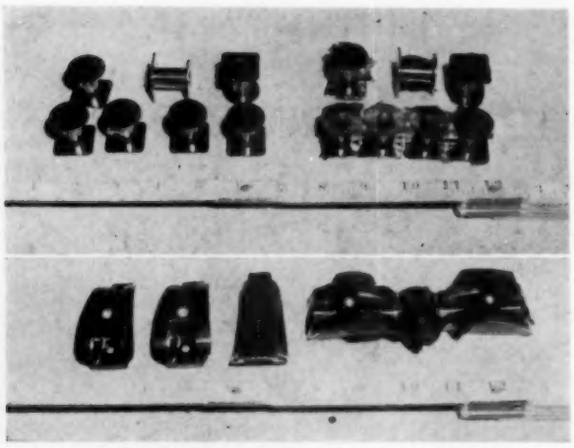


Fig. 2. Comparison views of parts before and after pellet deflashing (right and left, respectively) at Industrial Molded Products Co.: (top) electrical coil bobbins; and (bottom) sauce pan lid handles.

Application Studies

Some case studies will illustrate the savings obtained with automatic deflashing by soft-grit pellets.

Tumble-Blast Machines

SANGAMO ELECTRIC CO., Springfield, Ill., has been able to save $110.00 daily in direct labor costs as a result of using automatic pellet deflashing for the 21 different molded insulating parts produced at their plant. Some of these parts are black phenol-formaldehyde; some are cellulose filled melamine-formaldehyde; some are extruded glass-filled polyester moldings; and others are cellulose acetate moldings.

Automatic pellet deflashing in a Wheelabrator Tumblast (see Fig. 1) replaced hand filing, cutting, and the use of arbor presses in each of these cases. The machine has a deflashing chamber two cubic feet in capacity and deflashes loads of 100-6,000 moldings in from 2-12 minutes, depending upon the size and density of the pieces. A continuously moving belt-type conveyor in the chamber uniformly tumbles the moldings under the shower of pellets thrown by one wheel unit to assure that all areas of all the parts receive the same amount of deflashing action.

Nine operators were formerly required for this work, making a total deflashing time of 75.02 man-hours per day. The pellet deflasher, tended by only one operator, does the required work in only eight hours for a saving of 67.02 man-hours each day. In addition to the time saving, the appearance of the moldings has been improved by this more thorough mechanical deflashing.

INDUSTRIAL MOLDED PRODUCTS CO., Chicago, Ill., also uses a two-cubic foot-capacity tumble-blast deflasher which replaced plain tumbling barrels for processing 75 types of phenolic moldings. Advantages found here included not only the elimination of considerable manual deflashing, but also the elimination of chipping and breaking of moldings during deflashing.

With an electrical coil bobbin molding that measures one cubic inch in size (see Fig. 2) 400-500 pieces are deflashed at one time in five minutes. The edges of the part formerly required filing after tumbling by the previous method, but now do not. Sauce pan lid handles, 2½-inches long and 1½-inches wide (see Fig. 2) are now being deflashed at the rate of 900 pieces per load in five minutes. A 2¼-inch long, ¾-inch wide insulator contact blade for a timer is pellet deflashed at the rate of 1,000 pieces per load in two minutes, for a man-hour saving of about 50%.

SMITH & STONE, LTD., Georgetown, Ont., Canada, uses a pellet deflasher of the same type to handle the variety of parts in its production to replace manual handling. One typical part handled is a socket shell of which 50,000 moldings are now deflashed per hour, as compared with the 37 hours formerly required for this quantity. Similar savings on all parts made it possible for the company to amortize the pellet deflasher in less than one year.

SYNTHANE CORPORATION, Oaks, Pa., uses a two-cubic foot capacity Wheelabrator (see Fig. 3) for deburring and defuzzing hundreds of laminated plastic parts, including ball bearing retainer rings, rotor vanes, ignition breaker arms, coil forms, etc. The company reports that deburring costs have been cut an average of approximately 35%.

A typical piece with an inside diameter of 5½-inches, an outside diameter of 6⅜-inches, and 1⅜-inches long is deburred and defuzzed in the Wheelabrator at the rate of 375 pieces per hour. On this piece, the cost of the pellet operation is approximately $14.54 per thousand pieces, or about 20% of what the manual finishing formerly cost. Savings permitted the machine to be amortized in one year, and working conditions were improved by the elimination of any danger of cuts and nicks to the operators' hands.

Fig. 1. View of the deflashing compartment in the Wheelabrator pellet deflasher at Sangamo Electric Co.

Table-Type Machines

A slightly different type of machine is used by companies whose moldings are large, bulky, or fragile and cannot withstand a tumbling action in conjunction with the pellet shower. Parts in this category would include radio cabinets, bases for circuit breakers, etc. A machine of this type employs tables mounted on a spider to carry the work into and out of the deflashing zone. As the spider rotates the individual tables in and out of the pellet hurling zone, the individual tables also rotate so that all areas of the work are adequately exposed to the deflashing action.

A prominent Chicago custom molder uses both table-type and tumble-blast machines (see Fig. 4) to handle all the alkyd, mica, and phenolic moldings in production. The table unit handles parts like television convertor cases, switch plates, and photo tube covers, while a five cubic foot capacity tumble-blast unit takes care of such parts as bases for sewing machine housings, capacitor can tops, and switch cases. One man operates both machines. The 7-inch long, 4½-inch wide TV convertor case is presently handled at the rate of 400 per hour, as compared with the previous rate of 100 per hour, and both punch press and manual filing operations are eliminated.

In the case of the 8-inch long, 3¼-inch wide, ⅜-inch thick switch plate, 450 per hour are deflashed presently as compared with the former rate of 40 or 50 per hour. The sewing machine housing base, 2¼-inches long, 1¾-inches wide, and one inch thick, is presently handled at the rate of 18,000-24,000 per hour, whereas the former rate was only 9,000 pieces per hour. All these savings have made it possible for the company to operate with 50% less labor in the deflashing department, and efficiency has been increased up to 170% on some jobs.

Fig. 4. Two models of pellet deflashers at the plant of a prominent Chicago custom molder: (extreme left) tumble-blast machine; and (extreme right) table-type unit. One operator runs both machines, operating the table-type unit while the other machine is automatically going through the deflashing cycle.

SQUARE D CO., Peru, Ind., has three pellet deflasher units, two of which are two-cubic foot tumble-blast models and one is a table-type unit. Typical of the savings from the table-type unit are the figures concerning two plastic parts: On one, deflashing time was cut from 113 down to 10 man-hours per thousand pieces; and on the other, the time was cut from 22 hours down to 8 hours per thousand pieces.

Fig. 3. Burrs and fuzz being removed from laminated plastic retainer rings for ball bearings at Synthane Corp.

Need for Mold Maintenance

It should be realized that although such savings are available, the pelleting process is not a cure-all for defining ills. Mold maintenance still is important, so that flash will remain thin enough to be snapped off by the pellet action without injurying the parts. As previously mentioned, the soft pellets will not remove flash beyond 0.008-inch in thickness without damaging the parts. In such cases, manual methods must be resumed. Even when the flash does not reach 0.008-inch in thickness, the thicker it is the longer the deflashing time by either pellet method of removal. Proper mold maintenance will save a great deal of money for a molder in the long run by reducing deflashing costs.

Selection of Deflashing Machine

The question naturally arises as to which type of deflashing machine is best suited for a given application. It is difficult to set down a blanket set of rules since certain problems may require special treatment. It is possible, however, for positive determinations to be made in advance by the use of actual demonstration laboratories. Most reputable pellet deflasher manufacturers maintain these laboratories which are equipped with full-size production machinery. Customers can send in batches of production parts and have scientific determinations made as to the type and size of equipment best suited to their application.

—THE END

Plastics as Capacitor Dielectrics—1. Cellulose Acetate

The first of a five-part series on plastics being used as dielectrics or insulators in the electrical industry.

GEORGE MISTIC, *Director of Research*
Condenser Products Company, Division of
New Haven Clock & Watch Co., Chicago, Ill.

The function of a capacitor depends mostly on the dielectric, the insulating material between the two metal plates (usually aluminum). A series of typical manufacturing operations for capacitors is shown in Figure 1.

For years the applications of capacitors were limited by the types of dielectric materials which were available. Until the late 1930's, paper and mica were the sole dielectric materials used, and capacitor development was quite stagnant and limited to the use of different liquid impregnants.

Over the past 15 years, hundreds of synthetic dielectrics have been investigated by our company. Some have been given only a cursory glance and discarded. Others have been researched extensively before being shelved for possible future needs. Five plastic materials have been incorporated into the capacitors manufactured today: cellulose acetate, polyethylene, polystyrene, Mylar, and Teflon films. These films are uniform throughout; an important factor in dielectrics.

Properties of Cellulose Acetate

In this article cellulose acetate will be dealt with as it leads the plastic dielectric list chronologically. Of several dozen materials originally tested, cellulose acetate was the most acceptable. It is relatively low in price; is of uniform thickness; has a high dielectric constant and high dielectric strength; and its physical qualities are not affected adversely by high ambient temperatures. Our company developed a special processing technique for this film so that it could be impregnated with suitable insulating oils for use in high voltage capacitors.

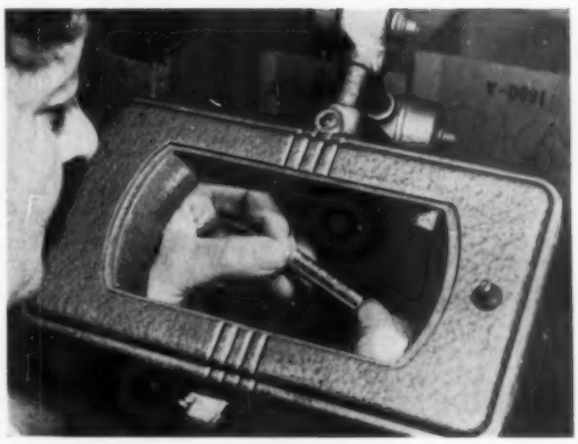
A major difficulty in those early days was the amount of water vapor held by the film. The porous nature of paper is advantageous when surface moisture or other closely-held moisture is to be removed from a roll-wound capacitor. In a solid dielectric, such as acetate, it is more difficult to remove the moisture from the closely held leaves of plastic film wound in a tight roll. This moisture as high as 8% of the weight of the plastic film, caused high power factor (which is a poor property), high leakage currents, and a short service life, particularly at high temperatures. Dielectric constant increases with an increasing amount of moisture, but the other deleterious effects of moisture wipe out this advantage.

Although acetate film made today still has the characteristic of high moisture retention, perhaps 99% of this included water vapor can be removed by use of high vacuum and temperatures. Entirely closed impregnation systems prevent resorption of moisture, and hermetic sealing of the capacitor containers provides protection from external deleterious conditions.

Table 1 shows the effects of moisture on the electrical properties of cellulose acetate at room temperature:

As for heat stability, the film shrinks 0.05-0.20% after 48 hours at 60° C., and 0.9-1.5% after 48 hours at 125° C. This small amount of shrinkage does not appreciably affect the stability of the capacitor when it is subjected to continuous temperatures and voltages. The capacitance drifts less than 2% in 1,000 hours of opera-

Fig. 1. Typical manufacturing operations for capacitors: (top to bottom) (A) Controlled winding of plastic dielectric film and aluminum foil; (B) Wire "pig tails" are soldered to capacitor end-plates; (C) Assembly is inserted into casing tube which is cadmium-plated brass; (D) Inspection includes checking for visual defects under a magnifying glass.



tion when performing at 65° C. under 150% of rated voltage.

Table 1. Effect of Moisture on Electrical Properties of Cellulose Acetate

Relative Humidity,	Volume Resistivity,	Dielectric Strength,	Dielectric Constant		Power Factor, %	
			At 1 Kc.	At 1 Mc.	At 1 Kc.	At 1 Mc.
%	Ohm-cms.	V/mil.				
0	10^{15}	4000	3.8	3.5	1.5	2.3
50	10^{13}	3000	4.8	4.4	1.6	3.1
98	10^{10}	1800	7.5	7	3.7	3.7

Effects of Impregnants

Several impregnants are used in paper capacitors. The electrical characteristics of the capacitors are affected by both the paper and the impregnant. This type of construction permits tailoring the impregnant to obtain certain needed characteristics for each specific application.

However, disadvantages arise in manufacturing because of dissimilarities in the two dielectrics, paper and oil. Capacitors can be assembled under pressure to reduce the thickness of the oil film and overcome the effects of this dielectric. On the other hand, conductive particles in the paper necessitate the use of minimum pressure to ensure the presence of an adequate oil film to reduce this deleterious effect.

In the manufacture of capacitors using a solid film of dielectric such as cellulose acetate, pressure and impregnant have very little effect on capacitor characteristics and performance. The plastic film contributes practically all the electrical characteristics, and the light film of impregnating oil contributes volts-per-mil rating and to corona suppression.

As can be seen from Figure 2, the power factor of mineral oil is a fairly constant 0.015% over the temperature range from —60 to +65° C. For a mineral oil impregnated paper condenser at a test frequency of 60 cycles, the power factor at —60° C. is 1.5%, and this value drops to 0.3% at room temperature and above. For cellulose acetate impregnated with mineral oil, the power factor reaches a maximum of 1.7% at —40° C., and a minimum of 0.65% at 65° C. At one kilocycle these values are higher, and the power factor of cellulose acetate alone is nearly identical to that of the impregnated acetate shown in Figure 2.

Similarly, the effects of temperature and frequency on capacitance of cellulose acetate film condensers are almost entirely dependent on the characteristics of the film itself, whereas the impregnant in paper condensers is the dominating factor.

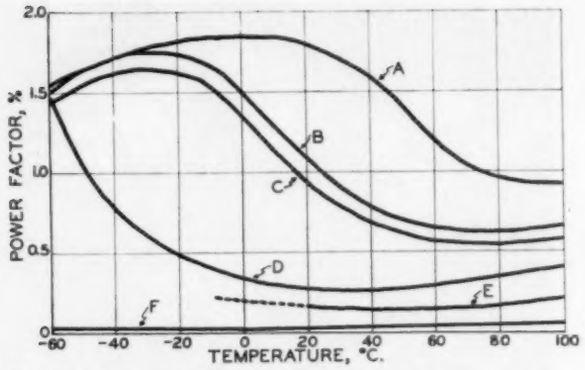


Fig. 2. Effect of temperature on power factors of dielectrics: A—mineral oil impregnated cellulose acetate at one kilocycle; B—mineral oil impregnated acetate at 60 cycles; C—unimpregnated cellulose acetate at 60 cycles; D—mineral oil impregnated paper at 60 cycles; E—unimpregnated paper at 60 cycles; and F—mineral oil.

Electrical Characteristics

One of the most important functions of the insulation or dielectric material of a condenser is the storing of electro-static energy. The term used to express this ability is the dielectric constant, and this constant uses air as a basis of comparison. The dielectric constant of air is one and that of cellulose acetate is four. Essentially, this means that the plastic dielectric will store four times as much energy as an air dielectric when all other factors are equal. However, this picture is complicated by the fact that the dielectric constant is not at all constant. A capacitor can assume many values of capacitance depending upon external effects of frequency, applied voltage, temperature, and electrification time.

Polarization

Most dielectric materials are either polar or practically non-polar. A non-polar material stores electrostatic energy instantly owing to the symmetrical structure of its molecules. This type of polarization, where the electrons are displaced from the nucleus of the molecule, is called electronic polarization. Plastics such as polystyrene, Teflon, and polyethylene, and liquids such as mineral oil, and silicone fluid impregnants used in acetate dielectric capacitors are essentially non-polar, since dipoles are induced by the electric field.

A polar dielectric of unsymmetrical molecular structure contains permanent molecular dipoles which can be rotated by the applied field. This phenomenon is called dipole polarization. Cellulose acetate, chlorinated diphenyl, castor oil, and other commonly used dielectrics are of a polar nature.

A third type of polarization, usually referred to as dielectric absorption, is interfacial polarization. The theory is that free ions in the dielectric move with the applied field and accumulate at electrode and dielectric film interfaces, and between interfaces of dissimilar dielectrics in the same applied field.

These three types of polarization are the most important in the study of capacitors. The quantity of energy assumed by the dielectric is dependent on these polarizations, as the dielectric constant.

The dielectric constant of non-polar materials is only slightly affected by temperature and frequency. Dielectric constants of polar materials are affected by frequency, temperature, and viscosity, and not by voltage. The dielectric constant of materials of high dielectric absorption is affected by temperature, voltage, and frequency.

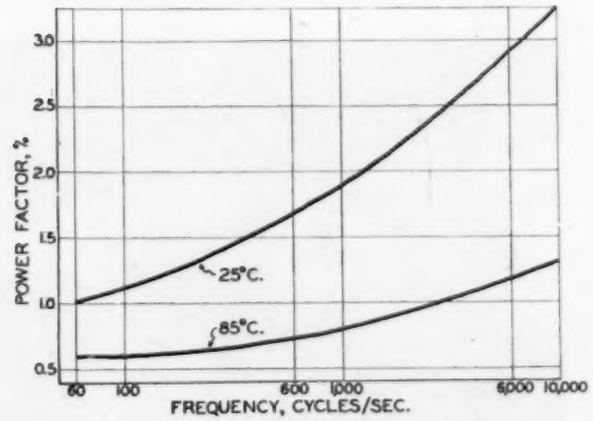


Fig. 3. Effect of frequency on power factors of impregnated and unimpregnated cellulose acetate at different temperatures.

Power Factor and Capacitance

Figures 3 and 4 illustrate the importance of polarization and its effects on dielectric constant. Figure 1 has shown the power factor variation of the polar material cellulose acetate with temperature and frequency, and the effects of mineral oil which is essentially non-polar. Figure 3 shows the effects of frequency and temperature on the power factor of cellulose acetate.

Figure 4 shows the effects of temperature on percent capacity change at one kilocycle. The curve for both unimpregnated acetate and silicone oil impregnated acetate is identical, and the effects of mineral oil are slight. This can be compared with the effects of polar and non-polar impregnants on the capacitance of a paper condenser.

Dielectric Absorption

Dielectric absorption is encountered in practice after shorting a charged capacitor, when the voltage across the terminals builds up to a maximum. This residual voltage can build up to 5,000 volts by 15 minutes after discharging for one second a mineral oil impregnated cellulose acetate condenser charged to 100,000 volts for one hour. In this article the percent absorption is defined as the maximum recovery voltage multiplied by 100 and divided by the charging voltage. In the above example, the absorption is 5%.

For mineral oil impregnated acetate, the absorption for most applied voltages is approximately 5.2% at room temperature, 5.7% at 50° C., and 6.2% at 75° C. Mineral oil impregnated paper condenser absorption voltage is more complex since the effects of temperature and charging voltage are greater. For small charging voltages at room temperature, paper has an absorption of 3.5%. At elevated temperatures the absorption is as high as 20% for low voltages, and drops rapidly to less than 5% for higher charging voltages.

Cellulose acetate film using no impregnant has an absorption factor of less than two percent for all voltages and low temperatures, however, the voltage rating of condensers made from the acetate film alone rarely exceeds six hundred volts DC.

Insulation Resistance

The insulation resistance of a dielectric varies with applied voltage, time of charge, and temperature. The capacitor is charged with 100-500 volts, and the insulation resistance is measured after a two-minute period of electrification. The capacitance multiplied by the insulation resistance is usually given in terms of megohms microfarads (or the insulation resistance of an equivalent one-microfarad capacitor).

Due to the effects of dielectric absorption, the two-minute charge time was selected as a standard electrification time in the capacitor industry for determining insulation resistance, since a longer charge time will decrease the leakage current so that the insulation resistance will improve steadily.

As illustrated by Figure 5, the insulation resistance of mineral oil and silicone impregnated acetate is comparable to the same impregnant used with paper dielectric. Cellulose acetate insulation resistance alone is somewhat higher.

Applications

Cellulose acetate capacitors find use in power circuits and in many types of direct current applications.

Power Circuits

Due to the power factor limitations of acetate film, this type of condenser is somewhat limited in applications involving power circuits of higher frequencies. In certain applications involving temperatures from —40 to +10° C., acetate film has advantages over certain papers impregnated with various types of chlorinated diphenyls because the dissipation factor of these paper units becomes too great owing to increased viscosity of the impregnant. Where a certain amount of power loss can be tolerated in 60-400-cycle circuits, cellulose acetate can be used because of self-heating of the dielectric which results in improved power factor and higher corona starting voltages.

Direct Current Applications

The chief advantage of cellulose acetate film is its relatively high dielectric constant and volts-per-mil rating in applications involving potentials of 2,000 volts or higher. In high voltage applications for the same capacitor size, the acetate capacitor has 150-200% greater voltage rating than an impregnated paper unit. The restriction to high voltage is due mainly to the fact that acetate film is made in sizes approximately ¾-mil thick, whereas paper can be made thinner than ⅜₁₀-mil. As a result paper capacitors have a considerable saving in capacity per size in low voltage ratings.

Where space is critical, ambient temperatures range up to 125° C., and high voltage is encountered, the oil impregnated cellulose acetate capacitor outperforms most paper capacitors. Such conditions are found in

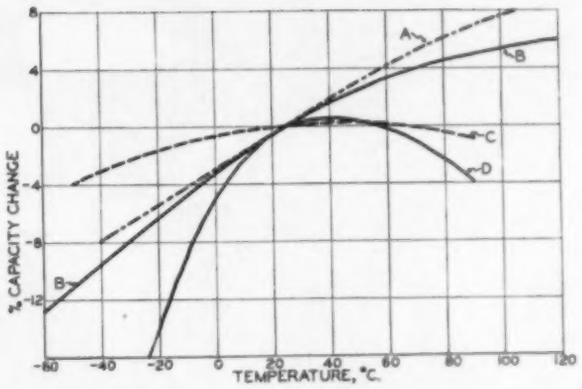


Fig. 4. Effect of temperature on % capacity change (from room temperature capacity) at 60 cycles. A—mineral oil impregnated cellulose acetate; B—both unimpregnated acetate, and silicone fluid impregnated acetate; C—mineral oil impregnated paper; and D—paper impregnated with chlorinated diphenyl.

DC filters in high voltage power supplies, and in voltage-doubling circuits where the film is stressed at 1,600 volts per mil at 65° C. It may be well to note here that the procedure for determining the safe operating voltage for acetate film capacitors for a 1,000-10,000 hour life at any particular ambient temperature is performed in accordance with JAN life-test specifications for paper capacitors (JAN C-25 and JAN C-91).

Another use is in surge generators. Here the service is not severe, and replacement of one defective unit of each hundred capacitors in a year's time is not objectionable. The dielectric can be used at working stresses higher than 2,000 volts per mil.

Other uses in which cellulose acetate dielectric capacitors prove reliable are energy storage welding, flash photography, x-ray equipment, dielectric and induction heaters, electronic timers, television and communication receivers and transmitters, motor filters, oscilloscopes, neon signs, vibrator buffers, arc elimination, and AF and RF coupling and bypass applications.

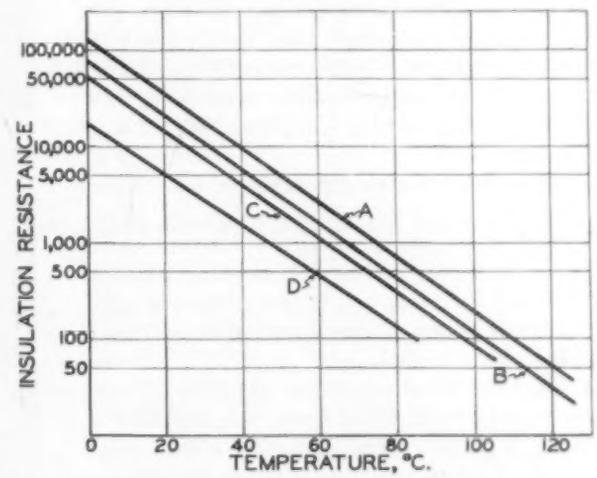
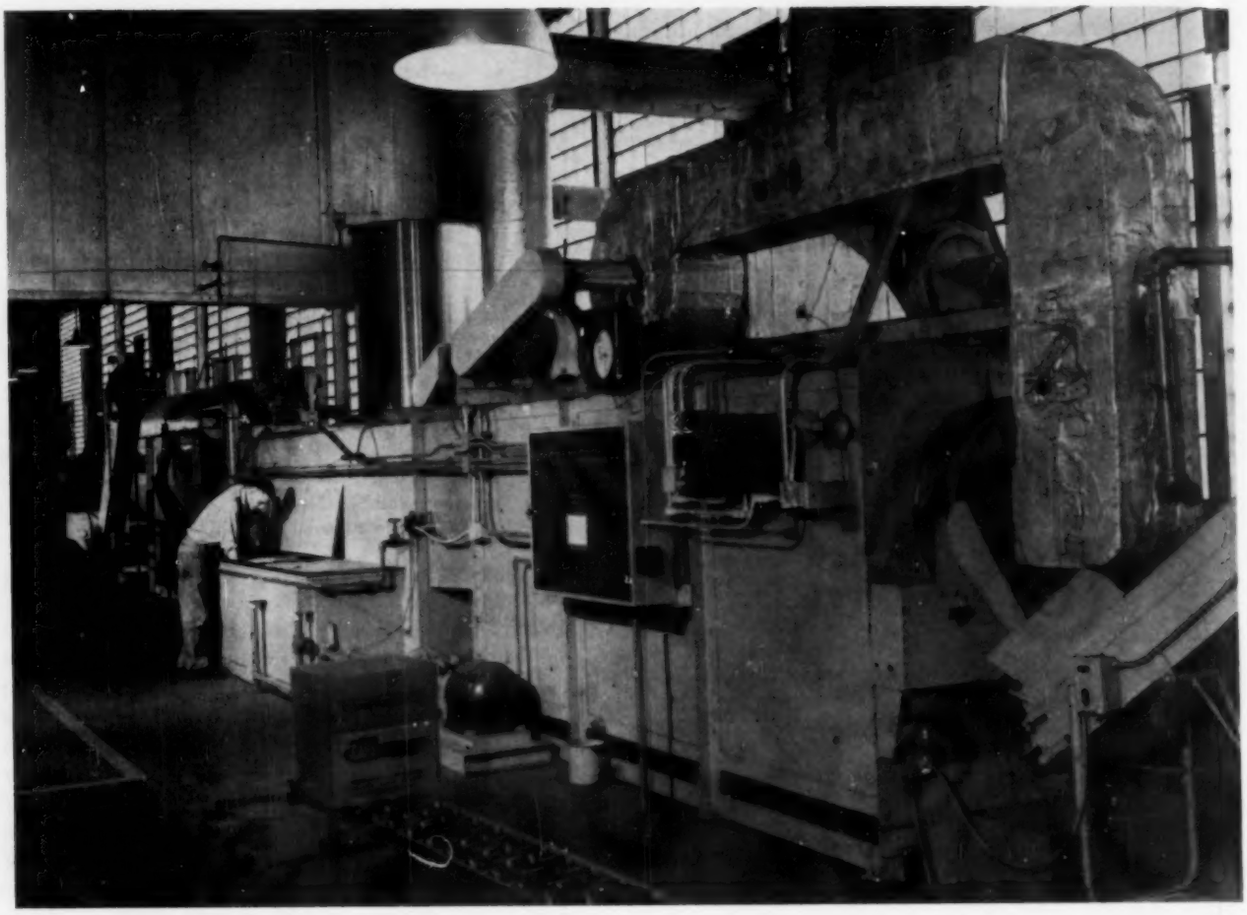


Fig. 5. Effect of temperature on insulation resistance (megohms × microfarads) after a two-minute charge at 200 volts; A—unimpregnated cellulose acetate; B—silicone fluid impregnated acetate; C—both mineral oil impregnated acetate, and mineral oil impregnated paper; and D—Halowax impregnated paper.

(Continued on page 164)

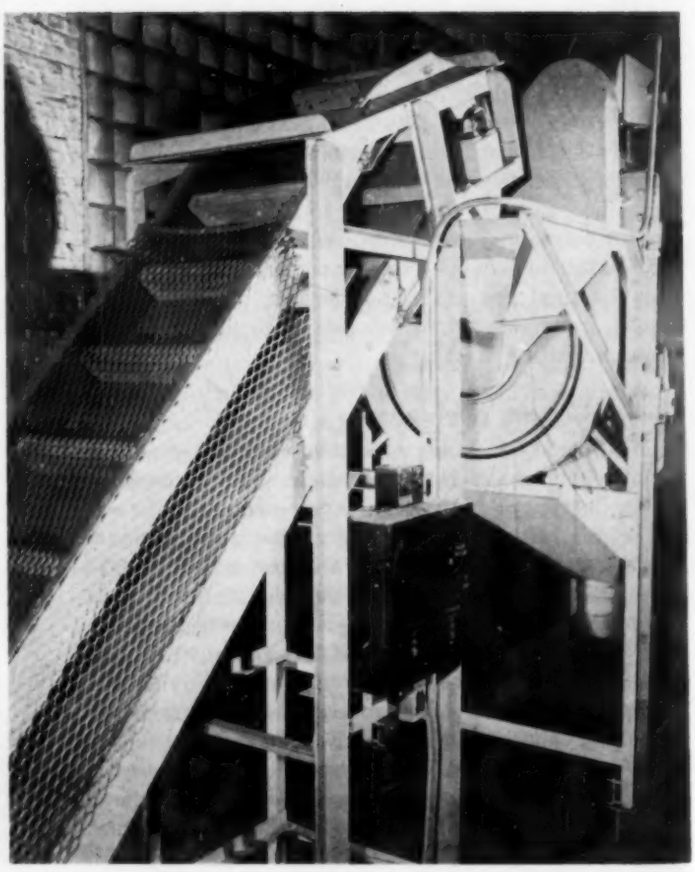


Washing Process Used for Molded Closures

A process for cleaning molded plastic closures, in which the parts are washed, rinsed, and dried, is being used by the Closure & Plastics Division of Owens-Illinois Glass Co., Toledo, O., in the production of all closures. The process eliminates a major problem plaguing closure manufacturers; the removal of small particles of plastic dust collected during the manufacturing operations. Previously, such dust was removed by a compressed air blowing operation.

The closure washing equipment (see upper photo) consists essentially of a long drum, about 35 feet in length, containing a rotating spiral conveyor which carries the closures through the washing, rinsing, and drying sections in turn. The feed section of the installation is shown in the photo (right).

Processed closures are not only free of any dust particles and water spots, but also have a highly lustrous appearance for added sales appeal. Chrome plating facilities have been installed in all closure plants of the company, and all molds are given smooth, lustrous plated surfaces. Any worn mold surfaces are immediately repolished and replated to ensure continued high quality of the closures produced.



JULES PINSKY, *Chief Physicist,*
Plax Corporation, West Hartford, Conn.

Photo by Heilpern

Practical Aspects of Polyethylene Permeability and Chemical Resistance[1]

Data are given on the resistance and permeability of polyethylene to 80 chemicals, and the practical application of these data is discussed.

Polyethylene, like the teen-age boy who has grown too fast, has often been the object of misunderstanding. In the first days of its commercial importance, polyethylene was considered as the wonder plastic, inert to anything and everything. This inertness suggested one of the first polyethylene bottle applications, the packaging of concentrated hydrofluoric acid.

Then various reports and rumors took over. Polyethylene was reputed to crack violently on contact with methyl alcohol at room temperature. Polyethylene was "found" unsatisfactory for cable usage. Polyethylene was whispered to be unsuitable for many packaging applications because of "suddenly developed" high permeability.

Of course, the serviceability of polyethylene lies somewhere between its originally considered complete inertness, and its somewhat competition-muddied unusability. This report is intended to help arrive at a more intelligent appraisal of the effect of chemicals on polyethylene from the standpoints of both permeability and chemical and physical attack. It is hoped that proper usage of data presented will allow for better-engineered utilization of its properties.

The data to be discussed is taken from work done by the Plax research, development and engineering laboratories. Much of this work was done on contract by the Air Force and the Plax findings were forwarded to the Air Force in two reports: "Investigation of the Shelf Life of Liquids in Polyethylene Bottles"; and "Theoretical Investigation of the Mechanism of Transfer of Materials Through Polyethylene." Copies of these reports will be available from the Department of Commerce, through the courtesy of the U. S. Air Force.

Nature of Test Program

The 80 chemicals used in this study were chosen for their general interest, and include some of the strongest acids, alkalies and solvents. These 80 chemicals were examined for their effect on polyethylene shelf-life after one year at temperatures of 130°, 100°, 70° and 32° F., respectively, and after four months at 165° F. The five temperatures for the 80 materials provided for 400 chemical-temperature combinations. However, since several of the chemicals were either too volatile or toxic to condition at high temperatures, only 354 combinations were suitable for test.

The classes of chemicals studied are shown in Table 1:

Table 1. Classes of Chemicals Studied

Inorganic acids	Ketones
Alkalies	Anhydrides
Organic acids	Terpenes
Alcohols	Nitrogen-containing compounds
Polyhydric alcohols	Aliphatic hydrocarbons
Esters	Aromatic hydrocarbons
Ethers	Chlorinated hydrocarbons
Aldehydes	Miscellaneous

Of the 354 chemical-temperature conditions, only 11 (or 3%) showed evidence of such chemical attack on the polyethylene that its physical properties were deterio-

[1] Presented at the tenth annual meeting of the New England Section, The Society of the Plastics Industry, Inc., Bretton Woods, N. H., Oct. 13, 1954.

rated. This chemical resistance is summarized in Table 2, as follows:

Table 2. Long-Time Chemical Resistance of Polyethylene

Temp., °F.	Exposure Time	Number of Chemicals Tested	Number of Cases where Attack Occurred
32	1 year	79	0
70	1 year	80	1
100	1 year	69	1
130	1 year	66	4
165	4 months	60	5
		354	11

A single blend of Bakelite's DE2400 polyethylene molding powder, with a melt index of 1.04, was selected and fabricated into the bottles, film and sheet used for these tests.

The shelf-life testing was done with standard four-ounce Boston Round type Plax polyethylene bottles that were made as one manufacturing lot. These bottles were sealed with phenolic caps which were lined with a 0.050-inch thick polyethylene film, so that even the vapor phase of each chemical would be in contact only with polyethylene.

The test bottles were then filled to shoulder height with each of the 80 respective materials. An additional group was filled to ¼-, ½-, and ¾-capacity to study the effect of liquid level on permeability. The test bottles and cups were then conditioned at the various temperatures. Figure 1 shows some of the test bottles and cups conditioned at 70° F. and 50% relative humidity. A typical group of bottles under test in an oven is shown in Figure 2. It can be seen that some of the conditions caused a tendency for some of the bottles to collapse.

During the shelf-life testing, the bottles were checked for weight loss at intervals of one, five and 10 days, and one, six, nine and 12 months. The bottles were weighed after each interval on the Sartorius Analytical balance to the third decimal place. Some of the tests were run with polyethylene film or sheeting fastened to aluminum test cups to determine the effect of polyethylene thickness on permeability and possible differences between the vapor and liquid phase permeability.

Test Results

Tensile and Elongation

Tensile and elongation properties, as well as susceptibility to stress corrosion cracking, were measured on strips cut from the bottles after long-time storage conditioning.

Naturally, any bottles which cracked during long-time storage had obviously been attacked. In addition, we arbitrarily considered any polyethylene bottle which showed a tensile strength of less than 1500 psi. and/or an elongation of less than 50% after long-time storage as being attacked. The bottle sections used for controls showed an initial average tensile strength of 2100 psi. and an elongation of 425%.

Fig. 1. Some test bottles and cups being conditioned at 70° F. and 50% relative humidity.

Fig. 2. Oven conditioning of test bottles. Some bottles show a tendency to collapse.

Thus, of the 80 materials tested, only concentrated nitric acid caused attack at room temperature, while there were only five other materials that produced attack at the elevated temperatures. The materials that caused attack are shown in Table 3, with the values less than the 1500 psi. tensile or 50% elongation noted with asterisks. Other tensile values are presented to demonstrate that even these materials did not cause attack at the lower temperatures.

This chemical resistance data for polyethylene is important for contemplated applications of the plastic in chemical ware, chemical storage tanks, drum liners, piping, etc. It is reassuring to know that, in general, polyethylene is not generally attacked on long-time storage even by extremely corrosive chemicals.

Stress Corrosion Cracking

Another area in which "scare" propaganda on poly-

Table 3. Effect on Tensile Properties of Chemicals That Attack Polyethylene on Long-Time Storage.

	Storage Temperature									
	32° F.		70° F.		100° F.		130° F.		165° F.	
	Tensile, psi.	Elong., %	Tensile, psi.	Elong., %	Tensile, psi.	Elong., %	Tensile, psi.	Elong., %	Tensile, psi.	Elong., %
Nitric acid, 67%	2,050	445	1,360*	395	1,330*	0	5* (Note A)	0*	580* (Note B)	0*
Nitric acid, 20%	2,250	475	2,200	490	2,100	465	1,460*	320	1,500 (Note C)	0*
Diacetone alcohol	2,200	480	2,200	470	2,200	500	2,250	425	780* (Note D)	0*
Acetic anhydride	2,300	495	2,450	490	2,400	485	1,500	0*	1,500 (Note E)	70
O-xylene	2,300	470	2,150	425	2,200	440	2,100	440	1,340* (Note F)	50

Notes: A—29 days storage. C—29 days storage. E—42 days storage.
B—2 days storage. D—138 days storage. F—1 day storage.
* —Lowered value indicates attack.

ethylene has been spread is that of stress corrosion cracking. Some years ago, reports were current that thin polyethylene film wet with methyl alcohol would crack in two when bent 180 degrees. At that time, however, we found that Plax polyethylene film could be crease-folded in an alcohol bath at temperatures as low as —50° F. without cracking.

It is true that at one time polyethylene cable sheathing was subject to stress corrosion cracking. This problem was eliminated as commercial production methods improved and higher molecular weight resin became available.

Similarly, at one stage in the development of polyethylene bottles, some manufacturers had difficulty with cracked necks. Here, again, by choosing high molecular weight molding powder of a proper stress corrosion cracking resistance, and by good design engineering of bottle plugs, closures, etc., this trouble has been virtually overcome by most suppliers.

However, despite the elimination, on a commercial level, of many problems on stress corrosion cracking, we thought that it would be of value to determine whether long-time chemical storage would lower the stress corrosion cracking resistance of a polymer such as Bakelite's DE 2400. As shown in Figure 3, the necks were cut from the bottles that had been employed in the long-time storage tests. A stainless steel tapered plug with longitudinal grooves was then inserted into the neck of each bottle so that it caused an apparent initial stress of 800 psi.

The bottle neck and plug assembly was then introduced into a pan of Igepal CO, a severe cracking agent for polyethylene. The assembly has held under these stress conditions for a period of seven days, since previous test data have demonstrated that cracking almost invariably occurs within the first 48 hours if it is to take place at all.

Using this test procedure we found that only 29 of the 354 material-temperature combinations attacked the polyethylene so as to make it more susceptible to stress corrosion cracking. It should be emphasized, too, that even where a tendency for stress corrosion cracking

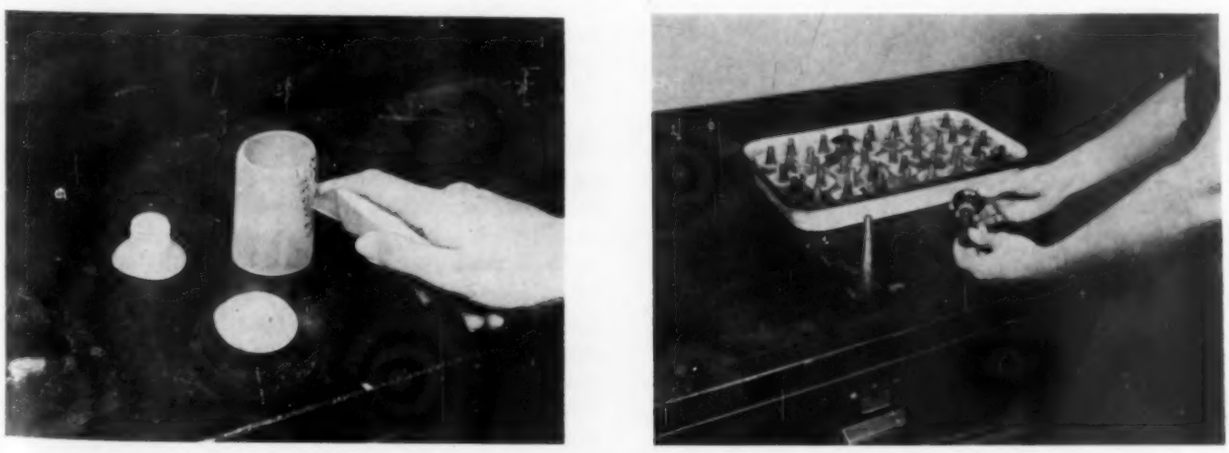


Fig. 3. Preparing specimens for stress corrosion cracking test: (left) Neck being cut from polyethylene bottle; and (right) Steel plug being inserted into neck to provide initial stress.

exists, for cracking to occur in practice it is necessary to have conditions which (a) cause a hoop stress of 800 psi. or more, and (b) entail the presence of a severe stress corrosion cracking agent.

Those materials which we found to cause this tendency toward stress corrosion cracking susceptibility are listed in Table 4.

Table 4. Materials that Cause a Tendency for Stress Corrosion Cracking Susceptibility

	Long-Time Storage Temp., °F.
Nitric acid, 20%	130, 165
67%	70, 100, 130, 165
Sodiumhydroxide, 10%	165
40%	165
Acetic acid, 56%	130, 165
Tertiary butyl alcohol	165
Glycerine	165
Ethylene glycol	130, 165
Butyraldehyde	100, 130
Benzaldehyde	100, 130, 165
Diacetone alcohol	165
Acetic anhydride	130, 165
Benzene	165
p-chlorotoluene	165
Ammonium chloride	165
Sodium carbonate	165
Sodium hypochlorite	100, 130, 165

Permeability

Polyethylene permeability has been for some time a field where only scant published data was available, and most work concerned itself with gaseous permeability. Naturally, permeability was the main quality under study in this testing. The permeability rate (P-factor) was obtained by averaging the weight losses for all of the test samples run at each temperature with a specific chemical. Five samples were run for most test conditions. The average weight losses were then plotted against time, and the slope of the curve thus obtained taken as the P-factor. A typical P-factor plot is shown in Figure 4.

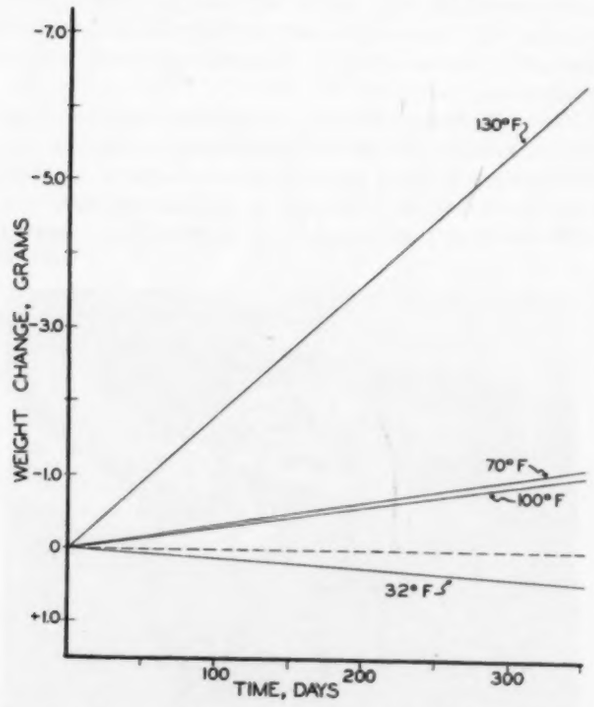


Fig. 4. Average weight-change curves for polyethylene with 36% sulfuric acid at various temperatures. Slope of each curve is the permeability rate (P-factor).

Table 5. Permeability of Polyethylene to Chemicals. Annual Weight Loss Groupings of Tests in Four-Ounce Boston Round Bottles

GROUP 1. Less than 3% Weight Loss per Year	GROUP 2. 3-10% Weight Loss	GROUP 3: 10% and Higher Weight Loss
Sulfuric acid 36%, 50%, 68%, 93%	Aqua ammonia 28%	Ethyl acetate
Hydrochloric acid 20%, 36%	Acetic acid 99%	Amyl acetate
Nitric acid 20%, 67%	n-Butyric acid	Diethyl ether
Phosphoric acid	Aniline	Dibutyl ether
Boric acid	Nitro-ethane	Butyraldehyde
Fluoboric acid	Ethyl mercaptan	Benzaldehyde
Hydrofluoric acid	Nitro-benzene	Acetone
Sodium hydroxide, solid 10%, 40%		Methyl ethyl ketone
Aqua ammonia 10%		Turpentine
Formic acid		Dipentene
Acetic acid 56%		Iso-propyl amine
Oxalic acid		n-Pentane
Benzoic acid		iso-Pentane
Methyl alcohol		Pentene-2
n-Propyl alcohol		n-Heptane
Allyl alcohol		Decane
n-Butyl alcohol		Tetra-decane
sec.-Butyl alcohol		Benzene
tert.-Butyl alcohol		o-Xylene
Octyl alcohol		p-Xylene
Phenol		Cyclohexane
Hydroquinone		Chlorobenzene
Ethylene glycol		p-Chlorotoluene
Glycerine		
Diethylene glycol		
Ethylene glycol monobutyl ether		
Dibutyl phthalate		
Formaldehyde 40%		
Diacetone alcohol		
Acetic Anhydride		
Camphor		
Acetanilide		
Lubricating oil		
Monochloroacetic acid		
Hydrogen peroxide 3%, 30%		
Silicone oil		
Water		
Ammonium chloride		
Sodium carbonate		
Sodium benzoate		
Sodium hypochlorite		
Formamide		

In Table 5 we have grouped the 80 materials studied into three classes. The first group shows those materials considered commercially packagable in a 4-ounce Boston Round bottle from a standpoint of less than 3% weight loss after one year's storage at room temperature. Concentrated nitric acid, though satisfactory from a permeability viewpoint, was not packaged because it attacks polyethylene. The second group represents a 3-10% annual weight loss, and the third group repre-

Table 6. Permeability Rates for Polyethylene to 80 Test Chemicals at 70° F.

	P-factor*
Sulfuric acid, 36%	—0.631
68%	+0.790
93%	+0.039
Hydrochloric acid, 20%	—0.123
36%	—0.853
Nitric acid, 20%	—0.161
67%	—0.170
Phosphoric acid	+0.063
Hydrofluoric acid	—0.214
Sodium hydroxide, solid	+0.090
10%	—0.196
Aqua ammonia, 10%	—0.620
28%	—2.090
Formic acid	—0.666
Acetic acid, 56%	—0.580
99%	—3.080
n-Butyric acid	—4.790
Oxalic acid	+0.084
Benzoic acid	—0.067
Methyl alcohol	—1.220
n-Propyl alcohol	—0.495
Allyl alcohol	—1.446
n-Butyl alcohol	—0.462
sec.-Butyl alcohol	—0.619
tert.-Butyl alcohol	—0.260
Octyl alcohol	—0.498
Phenol	—0.484
Ethylene glycol	+0.071
Glycerine	+0.046
Diethylene glycol	+0.078
Ethylene glycol-monobutyl ether	—0.666
Ethyl acetate	—16.550
Amyl acetate	—8.700
Diethyl ether	—313.000
Dibutyl ether	—85.500
Formaldehyde	—0.534
Acetaldehyde	—6.050
Butyraldehyde	—10.130
Benzaldehyde	—6.800
Acetone	—6.750
Methyl ethyl ketone	—12.600
Diacetone alcohol	—0.308
Acetic anhydride	—0.809
Turpentine	—47.000
Camphor	—0.293
Dipentene	—128.500
Aniline	—1.712
iso-Propyl amine	—40.750
Nitroethane	—2.710
Nitrobenzene	—4.930
n-Pentane	—526.000
iso-Pentane	—270.000
2-Pentene	—695.000
n-Heptane	—269.500
Decane	—71.200
Tetradecane	—14.600
Lubricating oil	—0.358
Benzene	—440.000
o-Xylene	—256.500
p-Xylene	—486.000
Cyclohexane	—251.000
Chlorobenzene	—455.000
Monochloro-acetic acid	—0.309
p-Chlorotoluene	—304.000
Hydrogen peroxide, 3%	—0.530
30%	—1.745
Water	—0.279
Sodium carbonate	+0.115
Ethyl mercaptan	—399.000
Sodium hypochlorite	—0.347
Formamide	+0.033

* Expressed in grams, after 24-hour contact for 0.001-inch thick film over an area of 100 square inches.

sents a loss of more than 10%. Thus, of the 80 chemical materials, 50 would be considered commercially packagable from a permeability standpoint in a standard 4-ounce Boston Round polyethylene bottle, and 60 packagable in a one-gallon bottle size.

It should be realized, however, that many applications do not necessitate a one-year shelf storage life.

The long-time study allowed accurate determinations for the first time of the rate of permeability or P-factor of polyethylene to chemicals. Presented in Table 6 are the P-factors at the 70° F. test temperature for the 80 chemicals. Sulfuric 50%, boric and fluoroboric acids; sodium hydroxide 40%; hydroquinone; Dubutylphthalate; acetanilide; silicone oil; ammonium chloride; and sodium benzoate do not have values listed because they show both gains and losses in weight of very slight magnitude.

These P-factors can be used to calculate the approximate weight loss of any polyethylene package whether it be in the form of a bag made from thin film, a small dispensing tube, bottle, or carboy.

The permeability of polyethylene must be related to a specific type, size, and shelf life of a package. In some packaging applications, such as drum liners, the problem of permeability is not even involved. This is due to the fact that, for permeability to occur in measurable quantities, the following conditions must exist: (1) solubility of the material in the polyethylene; (2) diffusion of the material through the polyethylene wall; and (3) evaporation of the material from the outward polyethylene surface.

In the case of a package such as a bag-lined steel drum, the air-tight nature of the drum obviously prevents the material from evaporating from the outer surface of the bag liner even though it may diffuse slightly through the liner walls. However, though permeability is not a problem in such a case, the effects of contact of the material with the inside of the drum must be considered.

Conclusion

The data presented here are proffered with the hope that they may enlarge on the general comprehension of polyethylene properties with regard to permeability and chemical attack. We feel that better understanding of these properties will result in more properly engineered polyethylene applications. —THE END

(Plastics—The Cosmopolitan Industry, Continued from page 150)

means: "Health, money, love, and time to enjoy them." In this philosophy, time is of the essence; the pace has been slow but is speeding up rapidly.

Mexico is one of the largest Latin American markets, especially for plastic materials. There are nearly as many branches of American plastics, rubber, and chemical companies in and around Mexico City as would be seen in New Jersey or Ohio. The Mexican government shrewdly prevents importation of any materials also produced locally, so a long-term future seems assured.

The Latin American nations farther south have independent and sensitive governments, and most of them are admirably assisting themselves in an effort toward national security and self-sufficiency. In Argentina, for example, the plastics industry has a promising long-term future, but is having difficulty treading water due to restricting regulations at a time when there is a need for a bold stroke of expansion. Because of its monopolistic governmental policy, Argentina has slipped backward industrially at a very critical time.

Brazil's financial condition needs to shake down and allow development of her tremendous resources. The plastics industry there is increasing in importance and booming along on a strong, long-term growth curve despite violent intermediate swings.

The inflation rampant in oil-rich Venezuela is in contrast to Peru where the economy is relatively stable. Here, the slow and steady progress of plastics is hampered mainly by limitations of population.

Political unrest in Bolivia, Guatemala, Colombia, and Cuba make business operations there interesting, even for the adventurous. Following the usual formula of risk and profit, Havana streets have more Cadillacs per curb length than Park Avenue. The fast tempo of governmental development programs is a stimulus to flexible business operations, such as plastics molding and fabricating.

On the other side of the world in the Far East, J pan is coming back fast and has almost completed rebuilding her industry. She now has a very active plastic materials and chemicals industry. However, the concept so desperately needed in Japan, of creating capital by means of technology, is not prevalent in many circles where the old fear of putting a man out of work by improved technology is deeply rooted. Completely new industrial techniques, such as plastics, are making major progress and doing much to supplant ancient work traditions with more modern philosophies of higher productivity and greater job opportunities through mass production methods.

A golden age is approaching in South Africa with its exports of natural resources which are improving living standards. Plastics manufacturing is slowly taking shape, and should ultimately play an important role in the economy of that area.

India's potential as a consumer has regularly attracted plastics impresarios, but the population's ability to purchase is so dependent on the gradually-awakening industrial life that progress has been slow at best. Throughout India, the lack of power and industrial facilities, coupled with destructive political unrest, have been the main deterrents to industrial progress.

As the largest and most diversified segment of the plastics industry, the American portion's greatness stems from its relatively recent commercial and technological expansion. In many instances, we have parlayed fundamental foreign technical discoveries into successful consumer products through the application of our mass production and commercial methods. This, in turn, has helped to establish plastics more rapidly in foreign economies which could not otherwise be ready for such developments.

The creative possibilities innate in plastics have captured the imagination and re-awakened the dormant craftsmanship of old-world artisans in a way that is slowly transforming the tempo of many a sleepy villa. In many such places, a small plastics molding plant has become the nucleus of a modern-day industrial renaissance. It stands to reason that we will gain by this revival of creative knowledge to the extent that we participate in it. —The End

(Plastics as Capacitor Dielectrics—
I. Cellulose Acetate, Continued from page 157)

Conclusions

Synthetic dielectrics are being accepted by equipment and component manufacturers in ever-increasing numbers. Cellulose acetate has proved itself to be a reliable dielectric over the course of many years' use in capacitors. There is no one synthetic film which has all the desirable characteristics wanted by a designer of equipment. Nevertheless synthetic film manufacturers have considerable leeway in altering chemical formulations and manufacturing methods to obtain certain desirable electrical properties.

The present disadvantage of not being able to furnish film thinner than 0.7 mil is being attacked vigorously by several manufacturers. At present, this limitation curtails use of the cellulose acetate dielectric for lower voltages since paper capacitors have an advantage here. At voltages over 2,000 volts, acetate has a decided advantage over paper in that it permits the manufacture of smaller size capacitors for each voltage rating.

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—The End

Alternate sheets of Epon and iron laminations (left) are used to make the stator, shown (right) with one slot cleaned out.

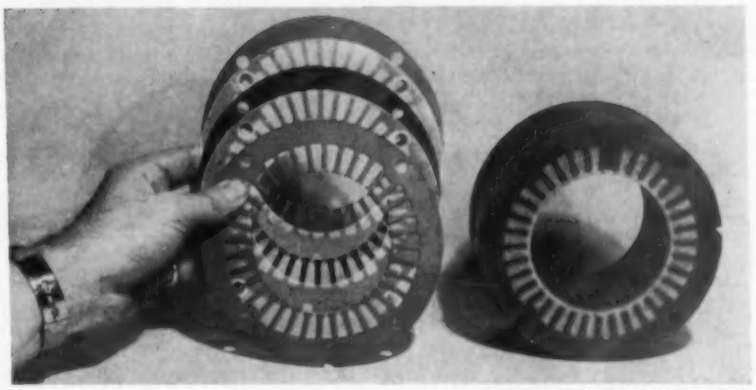


Photo by Shell Chemical Corporation

Epoxy Resin Solves Compressor Design Problem

A new concept in compressor design, whereby the actual compressor mechanism is impregnated with epoxy resin and placed inside the electrical driving members to form a fluid-tight pressure vessel, has been developed jointly by Wetmore Hodges & Associates, Redwood City, Calif., and Shell Chemical Corp., New York, N. Y. This design reduces the over-all size of the unit to only one-quarter that of a conventional motor-driven compressor, and eliminates about 60% of the dead weight. The entire unit consists of only 12 parts, as compared with 110 in conventional compressors.

Two developments led to the success of the new design. First, the gear type compressor was designed so that the ring gear drives the inner pinion. A positive seal is obtained at the back of each pinion tooth, and fluid leakage is eliminated. Second, the stator serves as the outer casing for the unit and must be impervious to all types of fluids. Shell's Epon epoxy resins, suitably formulated and cured, are used to impregnate the stator laminations and windings, making the entire stator a true pressure vessel that is leakproof at pressures to 350 psi. and temperatures from —20 to +250° F. The impregnation also protects against moisture or chemicals.

The stator consists of a laminated iron stack and suitable wire windings. In making the stack, very thin sheets of B-stage high temperature Epon were placed between alternate iron laminations, and the stack cured under high compressive stress. This stress extrudes most of the Epon, leaving an extremely thin, uniform layer of resin that binds and seals the iron laminations.

The windings are then applied to the processed stack structure. The assembly is placed in a high pressure mold, heated to curing temperature, and injected with a semi-liquid modified Epon. After curing, the stator is machined to remove excess plastic from the exterior and bore, and tested for pressure-tightness. The pump package is inserted into the stator to complete the assembly of the compressor.

Photo by Shell Chemical Corporation

After cleaning excess resin from the cured stator (left), the coil windings are inserted (center). After covering with Epon and curing, the finished stator mechanism (right) forms a leakproof casing for the compressor.

News of the Societies

Record Attendance Featured at SPI Canada Conference

Haywood Studios

Frank G. Rice, New President of the SPI (Canada).

A new high of more than 200 registrants and active participation and interest in the sessions highlighted the 13th annual conference of the Society of the Plastics Industry (Canada), Inc., held on February 22 and 23 at the Hotel London, London, Ont., Canada.

Eleven technical papers were presented during the morning and afternoon sessions on February 22, and the morning session on February 23. Other features of the conference included a luncheon on the first day, at which Professor Walter Thompson, University of Western Ontario, spoke on "Development of Administrative Skills"; meetings of the Society's extruders and reinforced plastics sections during the afternoon of February 22; the annual dinner on February 22, with a talk on "Sense and Nonsense" by Professor Marcus Long, University of Toronto; a luncheon session on February 23 at which Hiram McCann, "Modern Plastics," spoke on "Potentials in Plastics"; and the Society's annual business meeting on the afternoon of February 23.

New officers for the coming year were elected during the annual meeting, as follows: president, Frank G. Rice, Du Pont Co. of Canada, Ltd.; vice president, R. T. Todd, Irvington Varnish & Insulator; treasurer, R. W. Jackson, Canadian General-Tower, Ltd.; and councillor-at-large, P. O. Jeffreys, Bakelite Co.

Retiring president G. M. Scott, Dow Chemical of Canada, Ltd., reported on the Society's achievements during 1954, and the outlook for 1955 which he termed favorable. Cited as needed by the plastics industry were continued research on materials and processes; upgrading of finished products; the development of standards or specifications for materials and products; and strong selling organizations. The Canadian plastics industry is suffering from "import-itis," Mr. Murray said, because of high amortization costs for dies, especially in competition with imported products made from dies whose costs have been amortized.

Abstracts of Papers

"Current Applications of Plastics in Building," L. A. Contini, Monsanto Chemical Co. A review of current plastics applications in building foundations, structures, roofs, walls, floors, openings, ceilings, partitions, and mechanical elements.

"Some Plastic Packaging Films of Increasing Importance," W. E. Henderson, Visking Corp. A discussion of the properties and applications of non-toxic plasticized PVC films, and polyethylene films in standard and special forms. Among the special types are shrinkable, elastic, balloon, and black polyethylene films. Future improvements expected in polyethylene film are better mechanical properties, higher softening temperatures, lower permeability, and greater clarity.

"Mylar Polyester Film," J. C. Cawley, Du Pont of Canada. Mylar film is especially suitable for many types of electrical insulation because of its high dielectric strength, good dielectric constant, high volume and surface resistivity, and very good mechanical strength. Other fields of application include pressure-sensitive tapes, sound-recording tapes, drum liners, and thermal insulation.

"Beta Ray Gaging," P. J. Stewart, Isotope Products, Ltd. (Abstract not available).

"Reinforced Plastics in the Canadian Aircraft Industry," R. H. Bennett, Brunswick-Balke-Callender Co. of Canada, Ltd. (Abstract not available).

"Foams—Present and Future," J. A. Carr and B. B. Williams, Dunlop Canada, Ltd. Latex, vinyl, and polyurethane foams were compared with respect to methods of manufacture, fabricating techniques, properties, applications, and cost considerations. Properties discussed included density, hardness, load deformation, aging, chemical resistance, and low temperature flexibility.

"Use of Plastic as a Tooling Material," L. F. Bogart, Marblette Corp. Methods of making epoxy and phenolic tools were discussed, together with their use in forming dies and in gages and fixtures of all types.

"Effects of Nuclear Radiations upon Organic Materials," S. S. Jones, General Electric Co. Nuclear irradiation of organics has discolored some materials, made some plastics tougher while reducing others to powder, changed some liquids into solids, and taken the elasticity out of rubber. Irradiation will be useful where it can be used in small amounts to accomplish unique or unusual results, but cannot be expected to compete with conventional processes where it does not offer substantial advantages.

"Considerations of Injection Molding and Vacuum Forming Polystyrene," O. H. Yoxsimer, Westinghouse Electric Corp. Refrigerator door inner panels can be made by either vacuum forming or injection molding, and both processes yield satisfactory products. Injection molded panels are decidedly superior in appearance, while vacuum formed panels have cost advantages over a wide range of sizes and quantities.

"Packaging Agricultural Products in Plastic Films," S. A. Simpson, E. S. & A. Robinson (Canada), Ltd. The packaging properties of Pliofilm, cellulose acetate, polyethylene, and saran films were discussed, together with their applications for packaging grown and processed produce, dried fruits, meats, and other food products.

Connecticut Section Meets

SPE's Connecticut Section met March 15 in Bridgeport, Conn., to discuss welding as applied to the plastics field; attendance numbering 45. A film was shown entitled "New Welding Procedures," and John Duffy, Eutectic Welding Alloys Corp., addressed the group on "Salvage of Dies and Equipment Used in the Plastics Industry." Mr. Duffy explained how broken and damaged die components can be repaired through the use of proper alloys and welding techniques.

Boro Talks on Molding Methods

The February 22 dinner-meeting of SPE's Philadelphia Section was held at the Franklin Institute. Edward Boro, Durez Plastics & Chemicals, Inc., addressed the group on "New Concepts in Compression and Transfer Molding of Thermosetting Materials," stating that 90% of molders' difficulties are attributable to improper mold design.

Sufficient allowance for clearance and controlled closing rates limit the entrapment of air and other volatiles. Proper flow-section design is especially important in transfer or plunger molding; large round gates and runners being preferred. Restricted gates with hardened inserts help reduce mold erosion, and a weighed, preheating unit is now available to replace pre-forms in automatic molding presses.

Following the talk, Ed Derowski, of Penn Plastics Co., and new sectional president, introduced his fellow officers: vice president, Ed Fitzpatrick, F. J. Stokes Co.; treasurer, Norman Skow, Synthane Corp.; and secretary, Sam Greenwood, F. J. Stokes.

A sport film was also shown, followed by a drawing for two door prizes; an RCA Victor 45 RPM record player and a large stack of 45 RPM records.

Howard Talks on Fluorocarbons

The March 3 meeting of SPE's Southern California Section, held at Scully's Restaurant in Los Angeles, was addressed by Clarence Howard, W. S. Shamban & Co., on the topic, "Fluorocarbons Resins for Extremes." Ninety members and guests were in attendance.

The place of fluorocarbons in the general field of application was outlined by Mr. Howard, who also described the processing techniques used with both Teflon and Kel-F. Properties, as evidenced by ASTM testing procedures, were brought out, and specific applications in the electrical, electronics, and plastics industries were described in detail.

Western New England Meets

The Western New England Section, SPE, celebrated the receipt of its 200th membership application with a corned beef and cabbage dinner, served family style, and topped with an appropriately decorated cake. Seventy-three members and guests attended the meeting, which was held March 2 at the Bradley Field Terrace Dining Room, Windsor Locks, Conn.

Edward W. Vaill, Bakelite Co., presided over the technical program which consisted of slide-illustrated talks by William Higgins, Bakelite Co., and Amelio Cocci, Standard Tool Co. A summary of their addresses follows:

"Fabricating Cellular Polyethylene" was the topic of Mr. Higgins' discussion. He said that uniformly-heated flat dies were used to produce 10-inch wide sheets of high quality. Sheet thickness is determined by the die lip spacing, and the material will expand to twice the size of the opening. Attempts to extrude this material have been mostly unsuccessful due to breaking down of the air cells. Rods up to one inch in diameter have been made; however, sharpness of die detail are lost as the compound expands. Injection molding techniques usually fail for the same reasons, although reheating of a molded article close to its softening point reduces its viscosity and permits the collapsed gas cells to expand.

Mr. Cocci spoke on "Properties, Characteristics, and Advantages of Beryllium Copper Molds," describing the hardening properties and compressive strength of the alloy which shows the same recovery as hobbed steel. Properly and judiciously used, cast beryllium copper cavities and cores often mean decreased tooling costs through the casting phase.

New York Section Color Forum

"Styling Plastics with Color for Consumer Sales" was the subject under discussion at the March 16 dinner meeting of SPE's New York Section, held at the Gotham Hotel, New York City, with approximately 80 members and guests in attendance.

Faber Birren, color consultant, spoke on "Factors and Influences that Regulate Color Trends." He felt that color trends reflect a natural change within an unending cycle, originating with high fashion, running a three year course, and followed by a gradual slackening in popularity. Plastics, as volume merchandise, must follow a consistent pattern using the "vogue" colors. With the use of sales charts Mr. Birren traced the rise and fall in popularity for forest green, chartreuse, and flame red.

Practical aspects of color choice and color matching in the molding of styrene housewares were discussed by E. A. Nelson, Monsanto Chemical Co. He described his firm's approach in determining color choice, wherein free merchandise is given to a retail chain for display and customer purchase, without regard to the chain buyer's own color preference. In this manner consumer choice is unrestricted. Mr. Nelson also explained the use of two-color, controlled gradation charts emphasizing hue, lightness, and purity.

As an added feature, a sound-movie entitled "Peelable Plastic Packaging" was shown. The film demonstrated the use of Eastman's Tenite butyrate for protecting machine and precision parts. Table favors were distributed through the courtesy of Spec-Toy-Culars, Inc., Monsanto Chemical Co., and Plasticraft Corp. The meeting closed with a drawing for door prizes donated by Monsanto.

Plastic Tooling Discussed

Plastic tooling progress depends less on the development of "ideal" resins than on proper adaptation of the materials, according to Robert A. Grayson, Marblette Corp., Long Island City, N. Y., in a speech before the Appliance Engineers Society in Louisville, Ky., on March 9. Mr. Grayson was a featured speaker at the Society's plastic tooling forum, held at Appliance Park under the auspices of General Electric Co.

While plastic tooling cannot hope to solve all production problems, he felt that these materials had six fundamental assets: low cost, ease of production, less lead time required, facilitation of design changes, light weight, and corrosion resistance. In addition, intricate shapes and complex contours do not materially affect the die cost once the model has been completed.

Other speakers in the forum included Robert H. Voss, Warren Plastics & Engineering, Inc., Detroit, Mich., and Frank L. Bogart, Marblette Corp.

Low Pressure Polyester Molding

The 60 members and guests attending the March 14 meeting of SPE's Cleveland-Akron Section at the Spanish Tavern in Brecksville, O., were addressed by W. E. Wirsch, Rohm & Haas Co., on the topic of "Low Pressure Polyester Molding." He also presented a colored sound film entitled "Futures Unlimited," which covered several applications of low-pressure molding materials.

Jointly produced by Zenith Plastics Co., Libbey-Owens-Ford Glass Co., and Rohm & Haas Co., the film showed actual production processes for chair seats, radome structures, and airplane fuselages at Zenith's Gardenia, Calif., plant. Advantages of reinforced plastics, as demonstrated in the film, are high tensile strength per unit weight and low thermal conductivity. Comparative tests for tensile strength, in pounds, gave the following results: aluminum, 800; magnesium, 850; stainless steel, 960; and reinforced polyesters, 1,735.

Time studies conducted on fuselage construction revealed that reinforced plastics required one-fifth the engineering time, one-sixth the production manpower, and one-seventh the floor space of metals. Mr. Wirsch also discussed the use of premix compounds for insuring a uniform resin to filler ratio, citing the Chrysler heater housing as an example. The disadvantage of premix materials, however, is a lowered resistance to puncturing. Work on improving moisture resistance, resin-to-glass bond, and flame resistance was briefly outlined.

Newark Vacuum Forming Panel

A three-man panel discussion on the forming of thermoplastic sheets highlighted the March 9 meeting of SPE's Newark Section at the Military Park Hotel, Newark, N. J. The program, with Bob Carter of Celanese Corp. as moderator, attracted an attendance of over 80 members and guests.

The lead-off speaker was Jack Mighton, Dow Chemical Co., who discussed the high impact polystyrenes. Vacuum forming is finding increased usage in the manufacture of signs, displays, housewares, and refrigerator parts, he pointed out, and close control of all heating aspects is necessary to avoid non-uniform thinning of drawn parts. Plug techniques were considered, and Mr. Mighton concluded with a description of an ideal set-up for continuous sheet extrusion and vacuum forming, which featured a traveling die above the take-off conveyor.

Sanford Zimmerman, Vacuum Forming Corp., spoke on forming equipment, pointing out that 20-million pounds of sheet were vacuum formed in 1954, with drape forming the dominant technique. Although vacuum forming requires trimming of the ejected piece, the advantages of low cost tooling make it competitive with injection molding.

Frank Quinby, of Celanese Corp. concluded by discussing the forming of cellulosics and polyethylene, the latter still being in the developmental stage. Acetate and butyrate, with a thickness range of 3-20 mils, are being used primarily in the packaging of small items, thus filling the gap between thin films and injection molded containers. Mr. Quinby illustrated his talk with a number of displays on formed cellulose acetate packings.

Miami Valley Hears Curl

"Plastic Tooling For Plastics" was the topic of an address delivered by B. B. Curl, Jonasch Plastics Co., at the March 3 meeting of SPE's Miami Valley Section, held at the Wishing Well in Centerville, O. He explained to the 36 members and guests what his company has been doing in the field of plastics tooling, especially with regard to prototype molds, checking fixtures, paint spray masks, and embossing rolls.

Jonasch has also been doing research on the development of casting resins which will rapidly transfer heat into the mold cavities and retain a 400° F. temperature for four hours. At present, however, these resins cannot be used in injection molds under normal injection pressures.

Both Mr. Curl and Mr. Jonasch, founder of the company, were available for specific questions at an open forum following the talk. A door prize donated by the Section was won by Don Suer, Plastic Molding Co.

Southern Section Hears Savage

Following the presentation of a movie entitled "Plastics Is Your Business," R. J. Savage, Celanese Corp. of America, addressed the March 21 meeting of SPE's Southern Section on the subject of "Poly-

ester Resins." Forty-two members and guests attended the dinner-meeting which was held at Mammy's Shanty, Atlanta, Ga.

Mr. Savage defined polyester resins as polymerizable thermo-hardened resins which do not give off volatile end-products and, therefore, do not require pressure during molding operations. As supplied for commercial applications, polyesters are usually liquid in form and, as such, are actually mixtures of an alkyd resin dispersed in a monomer, usually styrene. The amount of styrene present, usually about 30%, largely determines the viscosity of the polyester.

Catalysts are used to convert the liquid resin to an insoluble, infusible solid through the use of heat or an accelerator. Since the polymerization of these resins is an exothermic reaction, heat is liberated, which affords one of the bases of classification. Polyesters are also classified as rigid, flexible, and semi-rigid resins; the latter being a mixture of the first two. The use of fillers can impart other properties such as light stability, fireproofing, and resistance to moisture and chemicals. Mr. Savage concluded with a discussion of molding methods, illustrating his comments with slides showing the matched mold process.

Elastomer-Plastics Group Meets

The February 15 meeting of the Elastomer & Plastics Group, Northeastern Section, A.C.S. was held at M.I.T., Cambridge, Mass., with 60 members and guests gathered to hear a panel discussion on tile flooring. Robert J. Ingraham and Philip N. Rolbin, both of Hood Rubber Co., spoke on rubber and vinyl-asphalt tile, respectively.

The processing of rubber tile was described by Mr. Ingraham, along with the ingredients employed and some of the problems encountered in calendering, mottling, molding, and curing. He also pointed out that rubber tile has shown a 1500% increase in consumption since the war, due to its low maintenance requirements.

Flexible, felt-back, and vinyl-asbestos types of vinyl tile were described by Mr. Rolbin, along with processing techniques and several formulations. He pointed up their chemical, abrasion, and stain resistance, and described special methods used to overcome blistering.

The March 10 meeting, held in collaboration with the parent Section, included afternoon and evening sessions, both held at M.I.T. The afternoon session featuring talks by Arthur M. Bueche, Knolls Laboratory, General Electric Co., on "Chemical Effects of Irradiating Polymers," and by Dennis M. Robinson, High Voltage Engineering Corp., on "Practical Sources of Radiation for Treating Polymers." Carl S. Marvel, University of Illinois, spoke on "Copolymerization of Di- and Tri-Substituted Olefins" at the evening session.

Talks on Expandable Polystyrene

Edwin A. Edberg, Koppers Co., Inc., addressed the 28 members and guests attending the March 17 meeting of SPE's Southeastern Ohio Section on the topic of "Expandable Polystyrene." A recent introduction, the material can be foamed in place, reinforced, glued, and laminated.

Available as small, hard beads, the material can be foamed either by the direct introduction of steam into a mold or by the steam probe method, with an expansion cycle from 20 seconds to one minute. Expansion of the beads against the walls of the mold results in the formation of a dense smooth skin. As an insulating material, expanded polystyrene is light, strong, buoyant, and more impervious to heat than cork, glass fibers, and mineral wool.

Molds can be made from steel, brass, bronze, or aluminum. Pressure created within the beads due to catalytic action is said to range from 10-15 psi., and the beads themselves are capable of expansion to 25-30 times their original size.

Fort Wayne Vinyl Forum

Approximately 106 members attended the third anniversary meeting of the Fort Wayne Rubber & Plastics Group, held February 10 at the Van Orman Hotel, Fort Wayne, Ind. A three-man forum on vinyl plastics highlighted the meeting, which also included nominations for 1955-1956 officers who will be elected by mail ballot.

William E. Manring, B. F. Goodrich Chemical Co., spoke on "Rigid Vinyls," tracing their development from a German substitute for steel to the present day where they find applications in chemical equipment and chemical-resistant rigid pipe. In contrast to European processing techniques, American fabricators usually add no plasticizer in order to preserve optimum properties. Temperature control is vital in conventional processing methods such as extrusion, calendering, and molding.

In a slide-illustrated discussion, F. W. Wurtzell, Bakelite Co., spoke on "Vinyl Elastomers—Progressive Materials in a Progressive Field." After reviewing the yearly production of vinyls and vinyl copolymers, Mr. Wurtzell described the various end-uses and different ways of processing. Technical problems arising during molding and extruding were explained in terms of heat requirements, an example being extruded wire and cable insulation which requires that the conductor be heated to 300° F. prior to coating.

Mansfield Williams, Monsanto Chemical Co., concluded the meeting with a discussion of "Vinyl Sheet and Plastisols."

PVC Panel Discussion

The Chicago Rubber Group was host to 30 SPE Chicago Section members on March 18 at the Furniture Club, Chicago, Ill. Over 280 attended the dinner-meeting which featured a panel discussion on PVC and its copolymers, Steve M. Lilla, Victor Mfg. & Gasket Co., served as moderator.

M. J. Kleinfeld, Naugatuck Chemical Co., spoke on "Extruded and Molded Vinyls," stating that the chief difference between them lay in the use of greater amounts of lubricants with the former. Two types of lubricants are used: internal, for lowering the processing temperature of the compound; and external, for reducing the adhesion or friction between the vinyl and the processing equipment.

The vinyl compounder has a wide choice of plasticizers; fatty acid esters for low temperature properties, polymeric for permanence, phthalates for rapid solvating power, phosphates for flame resistance, and petroleum derivatives for low cost. In plasticizer combinations, care should be taken to avoid a blend which would cause spewing or bleeding on the surface. While injection molding of vinyls is increasing rapidly, it is the extrusion field where vinyls have made their greatest strides in replacing rubber. An outstanding example of this would be the almost exclusive use of vinyl garden hose.

Abstracts of talks by F. W. Wurtzell and W. E. Manring appear in the report in this issue of the Fort Wayne Rubber & Plastics Group meeting on Feb. 10.

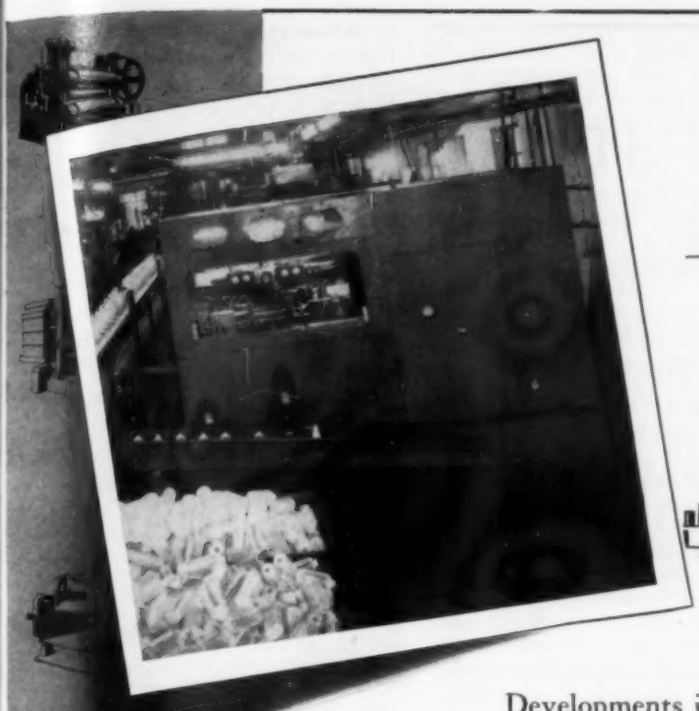
Materials Handling Conference Scheduled for May 16-18

"The Concept of Obsolescence" will be the theme of a three-day conference on new methods of materials handling to keep up with the increasing automation of industrial plants, which is to be presented by the American Materials Handling Society at the International Amphitheatre, Chicago, Ill., May 16-18, according to Clapp & Poliak, Inc., New York, N. Y., founder and producer of the event, which has made a grant to the society to underwrite the expenses of the conference.

The conference will coincide with the 6th National Materials Handling Exposition, May 16-20, also to be held at the International Amphitheatre. The show, said to be one of the largest in the country, will demonstrate all types of materials handling equipment under simulated factory conditions. More than 200 companies will exhibit.

In addition to discussing the latest systems and types of equipment for handling materials in the newest automation-adjusted plants, the conference will deal with the handling problems of older plants which cannot move from their present sites.

Topics to be discussed cover the wide range of cost reduction; effect of handling on production problems; receiving; warehousing; shipping; containers; pelletization; storage patterns loading and unloading facilities; purchase, leasing, replacement and maintenance policies; analysis of materials handling problems and its relationship to layout and production; water, rail and over-the-road carriers, and yard handling.



Developments in recent years have resulted in commercial bottle making machines using polyethylene materials with production methods based on the extrusion or injection moulding technique combined with the blowing process.

The Shipton Semi-Automatic Machine was designed for the smaller manufacturer who is likely to encounter a large number of medium-sized orders for different types and sizes of bottles.

The machine cycle is arranged to produce two types of bottles simultaneously in all sizes up to 2,300 cm.

The operator can work continuously between the two moulds provided the average wall thickness of the bottle does not exceed approximately 1mm. There is no waiting time for cooling off.

Both the automatic machine, illustrated above, and the semi-automatic machine are self-contained units which need only be connected with electrical and cooling water supplies for immediate production.

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NEWS of the INDUSTRY

Flexol 10-10 Output Expands

The expanded production of Flexol Plasticizer 10-10 and the availability of this material in large-scale quantities have been announced by Carbide & Carbon Chemicals Co., New York, N. Y. The plasticizer is didecyl phthalate, and is prepared from oxo decyl alcohols made at the company's new oxo alcohol plant at Texas City, Tex. The plasticizer was previously available only in small quantities, and increased production awaited field operation of the new alcohol plant.

Another Carbide plasticizer, Flexol 810, is made currently from oxo decyl alcohol in pilot plant quantities. The output of this product will also be raised as decyl alcohol production mounts at the new plant. The increased availabilities of these materials will broaden Carbide's position as a basic supplier of phthalate plasticizers. The company now has DOP (ethylhexanol), DIOP (isooctanol), 10-10 and 810.

Flexol 10-10 is expected to fill a long recognized need for a general purpose phthalate plasticizer with improved permanence properties. While applicable to all types of vinyl plastics, the plasticizer is expected to prove especially valuable in wire and cable compounds, automotive and other upholstery, film, profile extrusions, and plastisols and organosols. Other applications include nitrile rubber compounds and nitrocellulose lacquers.

The product is said to have the lowest volatility of all commercial phthalate (monomeric) plasticizers; excellent electrical properties; extremely low water extraction; very good heat and light stability; low color; freedom from odor; outstanding viscosity stability in plastisols; and good low temperature properties. In upholstery, it is claimed to provide good resistance to "rub-off." Specifications for Flexol 10-10 include: apparent specific gravity, 0.9656; boiling point, 279° C. at 10 mm. Hg.; freezing point, —65° C.; insoluble in water at 20° C.; solubility of water in plasticizer at 20° C., 0.2% by weight; absolute viscosity, 577 cps. at 0° C. and 113.2 cps. at 20° C.; and pour point, —35° F.

Reinforced Plastics Service

A complete service from design through production of molded fiberglass-reinforced plastics items has been announced by Durable Formed Products, Inc., New York, N. Y. In addition, technical service representatives are available for factory consultation and special problems. Durable specializes in small parts up to 20 by 20 inches, and works only on pre-impregnated fiberglass such as Sunform and Cordopreg.

Awards Made in Koppers Design Contest for Plastic Housewares

The presentation of awards to winners in the 1955 Design Competition for proprietary molders of plastic housewares was made by the sponsor, Koppers Co., Inc., Pittsburgh, Pa., at a banquet on March 21 in the William Penn Hotel, Pittsburgh. A total of 179 entries submitted by 77 molders were received in the contest which was designed to promote correct design and proper application of plastics in consumer houseware products. All entries, which were of regular or modified styrene, were judged on the basis of imaginative use of material, proper application of the material, good appearance and sound construction in relation to use, and apparent need or market potential.

All entries were divided into three classes: I—utilitarian products with operative construction features; II—utilitarian products with non-operative construction features; and III—decorative products with or without operative construction features. For the winner in each class, Koppers granted a one-year full-tuition scholarship for studies relating to product design at a qualified college or university of the molder's choice. The scholarships were granted in honor of the winning molders, and awarded to a qualified student selected by each college or university named.

First-prize winners in the three classes, respectively, were Federal Tool Co., Chicago, Ill., which chose Illinois Institute of Technology for the scholarship; Burroughs Mfg. Corp., Los Angeles, Calif., which named Carnegie Institute of Technology; and Injection Plastic Corp., Skokie, Ill., which selected the University of Illinois. The winning products were a two-color drop-door breakbox by Federal Tool; an 18-piece starter serving set of Luau dinnerware by Burroughs; and a high-gloss, rectangular shaped shelf planter by Injection Plastic.

Six honorable mention plaques were also awarded in the competition. These went to Autograf Brush & Plastic Co., New York, N. Y.; Gits Molding Corp., Chicago, Ill.; Meridian Plastics, Inc., Byesville, O.; Plas-Tex Corp., Los Angeles, Calif.; Polycraft Corp., Division of American Plasticraft, Chicago; and Quality Molding Co., also of Chicago.

The three-man panel of judges consisted of Clare E. Hodgman, Raymond Loewy Associates, industrial design consultants; Jesse H. Day, editor of the "SPE Journal"; and Hugh G. Wales, professor of marketing, University of Illinois. Mr. Hodgman was guest speaker at the banquet, and discussed "The Role of Plastics in Product Design." In the past, the plastics industry had not always shared the responsibility

All Nine Winning Entries in Koppers Design Competition for Plastic Housewares are Shown. First-Prize Winners were the Breadbox, the Dinnerware, and the Planters.

good management assumes for offering good taste to the public, Mr. Hodgman said. Today, the industry has overcome most of the early public prejudices, and new materials, techniques, and finishes, as well as better understanding of the basic problems, have contributed to more acceptable and successful plastic products.

Stokes Opens District Offices

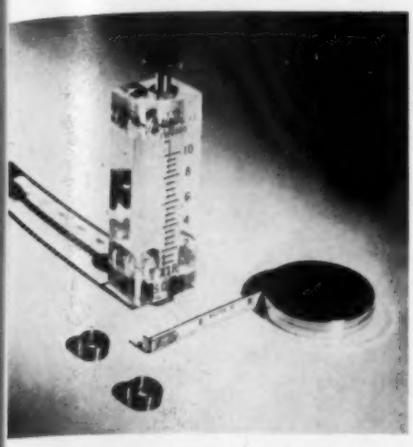
F. J. Stokes Machine Co., Philadelphia, Pa., has opened a suburban New York district sales office at 26 East First St., Mount Vernon, N. Y., and a branch office at 2165 Morris Ave., Union, N. J. Ralph H. Stalbaum will direct the Union operation, serving the new concentration of industrial firms in northern New Jersey.

Mobay Announces Price Cuts

With the advent of mass production of isocyanates and polyester compounds for the manufacture of polyurethane foams, Mobay Chemical Co., St. Louis, Mo., has announced price reductions for their Mondur TD and TDS monomers.

The former, a mixed isomer tolylene diisocyanate used in the manufacture of flexible foams will now cost $1.20 per pound in 55-gallon lots, instead of $1.40. The other isomer (TDS), from which rigid foams are produced, has been reduced from $2.00 to $1.50 per pound in similar quantities. Corresponding price reductions were made for both products in smaller lots.

Continued progress on the New Martinsville, W. Va., plant, which is now scheduled to begin operation in October, and delivery of German-made production machines are reportedly responsible for the price reduction at this time. Mobay has been operating an interim plant in Anniston, Ala., and importing additional requirements from Germany.



Acrylic Flowmeter with Wire Thread Inserts

Heli-Coil Inserts Protect Acrylic Flowmeter Threads

Precision variable-area flowmeters, made from corrosion resistant acrylic plastic by F. W. Dwyer Mfg. Co., Chicago, Ill., have reportedly been improved by the insertion of helically-wound stainless steel wire threads at their inlet and outlet connections. The Heli-Coil Inserts, a product of Heli-Coil Corp., Danbury, Conn., are said to have solved the problem of repeated engagement and disengagement of metal fittings without subsequent damage to the acrylic body of the meter.

The inserts, usually of ⅛-inch pipe thread size, protect the meter against thread-stripping caused by the repeated use of force in tightening the fittings. With these threads it is reportedly possible to strip the male fitting without damage to the plastic or removal of the insert.

Production caused no design problem, since threads in drilled holes are simply tapped to accommodate the outer diameter of the insert, which is threaded into place with an inserting tool to a ¼-½ pitch below the slight countersink.

Koppers, Firestone to Build Brazilian Styrene Plant

A styrene monomer plant at Cubatao, Brazil, with an estimated annual production capacity of ten million pounds, will be built and operated by the newly-formed Companhia Braziliera de Estireno, jointly organized by Koppers Co., Inc., Pittsburgh, Pa., The Firestone Tire & Rubber Co., Akron, O., and certain Brazilian interests.

The plant will be essentially under American ownership, since contracts provide for slightly more than 50% control by both Koppers and Firestone. One of the Brazilian firms involved in the proprietorship is Companhia Braziliera de Plastico (Koppers), a polystyrene manufacturer in which Koppers has had an interest since 1950.

The new company has been granted a loan of $2,500,000 by the Export-Import Bank to apply towards U. S. dollar costs in the construction of the plant. The remainder of the financing will be effected by sale of stock to the partners.

The major proportion of the plant's production will go to Brazilian producers of polystyrene items. The rest will go into the making of styrene latices and high styrene polymers for the manufacture of shoe soles and other goods.

To be situated adjacent to a government-owned refinery, the plant will be designed by Koppers' engineering and construction division, erected by Brazilian contractors, and operated under a management contract with Koppers' chemical division, which will furnish key personnel. Most of the plant personnel will be Brazilian, with total employees numbering about 125. Virtually all of the machinery for the plant will be made in the United States.

Koppers Plastics Trademarked

Koppers Co., Inc., Pittsburgh, Pa., has trademarked its entire plastics line. Formerly designated by number, the materials have been named as follows: "Dylene" for Koppers polystyrene; "Dylite" for expandable polystyrene; "Dylan" for polyolefine plastics, such as polyethylene; and "Dylex" for styrene-butadiene latices.

Pfizer Markets Itaconic Acid

Itaconic acid, a chemical intermediate with a wide range of applications in the plastics and allied fields, is presently available in carload lots from Chas. Pfizer & Co., Brooklyn, N. Y. Though more than 60 patents were issued covering its many uses, the high cost of production of the material had somewhat limited its potential. By a newly developed fermentation process utilizing a low-cost carbohydrate source, Pfizer is now able to produce the material on a commercial scale.

The compound has already been used to improve the toughness, light resistance, and dielectric properties of alkyd, polyester, polyamide, acrylic, fluorocarbon, cellulosic, isocyanate, and vinyl resins. An unsaturated dibasic acid which forms the usual carboxylic acid derivatives, itaconic acid also exhibits the reaction of a compound containing an unhindered double bond. A white crystalline powder, the chemical has the following physical properties:

Molecular weight	130.1
Melting point, °C.	167-168
Ionization constants at 25° C.: K_1	1.5×10^{-4}
K_2	2.2×10^{-6}
Specific gravity	1.63

MIT To Offer Plastics Course

A two-week special summer program on "Plastics in the Design of Building Products" will be offered June 14-24 by the Massachusetts Institute of Technology, Cambridge, Mass. The objective, as stated, is to stimulate the use of sound engineering and architectural principles in plastic construction design.

The staff will include authorities from industry as well as faculty members from MIT's architecture and design departments, all under the direction of Burnham Kelly, associate professor of city planning and chairman of the advisory committee on plastics in housing projects. The integrated program will consist of a series of technical lectures offered in the mornings, and correlated with afternoon sessions on design projects. The former will cover such topics as structural possibilities, predicted design behavior, character and properties, production, and marketing aspects; and the latter will consist of drafting and woodworking exercises.

Subway Uses Acrylic Diffusers

As the first step in an extensive relighting program, the New York City subway system has installed 350 new six-foot fluorescent fixtures with Plexiglas diffusers at the subway station beneath Grand Central Terminal. Installed in continuous rows along the platform edges, the diffused light offers 13 times the illumination formerly provided by 1,000 36-watt incandescent bulbs.

Each diffuser dish is six foot long, seven inches wide, and four inches deep. Formed in one piece, the adjoining ends are bridged with cement caps. The fixtures are dust tight, making it unnecessary to open them for periodic cleaning. The acrylic plastic, which is manufactured by Rohm & Haas Co., Philadelphia, Pa., is reportedly resistant to breakage and discoloration.

A test subway installation at the Fulton St. Extension was checked for light intensity every month for almost two years, and found consistently superior or equal to readings produced by other diffuser materials. Other reported advantages include the ability to contain the circuit wiring within the continuous line troughs, thereby eliminating the necessity for extensive conduit wiring; and the possibility of incorporating directional signals on the sides of the diffusers.

Grand Central Subway Station Illumination: (left) by Previous Incandescent Bulbs; and (right) by New Fluorescent Fixtures with Acrylic Diffusers.

Jet Oil Adopts Butyrate Pipe

Tenite butyrate pipe has been installed at Jet Oil Co.'s 20-well installation in Coulterville, Ill., thereby solving the problem of clogged metal lines due to paraffin accumulation. Nearly 5½ miles of two- and three-inch pipe were laid during the past three years, and it was found that the smooth inner walls of the plastic held no affinity for paraffin, which is contained in large amounts in all crude oils.

More than half of the pipe leads from well heads to storage tanks, the remainder being used in salt-water-disposal lines. Here, again, butyrate pipe is particularly well-suited due to its high corrosion resistance. The plastic pipe has obviated the expensive necessity of heating the metal pipes with a metal torch to keep the paraffin in solution.

The Tenite butyrate used in this installation, is made by Eastman Chemical Products, Inc., Kingsport, Tenn., and extruded as pipe by Crescent Plastics, Inc., Evansville, Ind., for distribution by General Oil Field Supply Co., New Harmony, Ind.

Stokes Molds Rigid PVC

A technique for molding such refractory plastics as non-plasticized polyvinyl chloride has reportedly been developed by Stokes Molded Products Division, Electric Storage Battery Co., Trenton, N. J. The new method is said to permit economical processing of rigid PVC in complex moldings, whether in small lots or large production runs.

The Stokes process maintains the natural chemical resistance and mechanical strength of the plastic, and permits molding to close tolerances. Even fully molded screw and bolt threads are practicable, according to Stokes officials. Molded rigid PVC valves and fittings are available through H. N. Hartwell & Son, Inc., and Lunkenheimer Co.

More than 375 million pounds of vinyl chloride were used in 1954, of which less than 10% was rigid PVC. In the opinion of some plastics industry representatives, only rigid PVC has sufficient potential to appreciably enlarge the vinyl chloride market. Stokes adds that 1955's backlog of orders show an increase of more than 800% over 1954's dollar sales volume for the rigid material.

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Dayton's Polyurethane Foams for Aircraft Insulation.

Dayton to Make 10-Million Pounds of Polyurethane Foam

Two million pounds of soft and rigid polyurethane foams will be produced this year by American Latex Products Corp., Dayton Rubber Co.'s subsidiary in Hawthorne, Calif., according to A. L. Freedlander, company president. Additional facilities being installed at the parent company's plants will add at least another eight million pounds of capacity.

Basically a combination of isocyanate and polyester resin, polyurethane foams can be made to any desired thickness, or sprayed as an insulant to form a permanent bond with metal, glass, and similar materials. They can be nailed, tacked, sewn, ground, and sawed. Only half the weight of foam rubber, which it outwears many times, the flexible foam is used as back-cushioning in airplane seats.

Not possessing the resilience of foam rubber, polyurethane foams find their principal applications as insulation materials, particularly in the aircraft industry where lightness is an important factor. In the unfoamed state, polyurethane is strong, tough, and elastic, and should find use in adhesive coatings, soles and heels for shoes, and tire treads.

Koppers Opens Kobuta Lab

A combination plastics laboratory and pilot plant facility has been opened in Kobuta, Pa., by Koppers Co., Inc., Pittsburgh, Pa. Designed to meet the needs of Koppers' customers throughout the world, the new unit will house reactors and provide space for centrifuging, drying, and extruding operations, as well as for storage. Allowance has been provided for expansion in any direction.

The control laboratory will specialize in the development and testing of plastic materials for injection molding, extrusion, and expansion into foams. F. B. Varga will supervise the development activities, and Dave Markowitz will serve as manager of the product development section. M. K. Dawson will be senior engineer.

Annual American Toy Fair

The biggest single trade show in the world, the American Toy Fair, was held March 7-16 at the McAlpin and New Yorker Hotels, and at 200 Fifth Avenue, 1107 Broadway, and other permanent company locations throughout New York City. A record 1,400 exhibitors displayed their wares, and over 14,000 buyers attended the event which was sponsored by the Toy Manufacturers of the U.S.A., Inc.

As in the past several years, plastics led the field in material applications. New developments were in designs, rather than in material or fabrication techniques; however, certain trends appeared to be evident, such as increased usage of polyethylene and laminated vinyl.

Some of the new product applications were Inflata Crib, a two-ply laminated vinyl bed; Pokey Doodles, foamed styrene building blocks in various colors; and doll carriages of reinforced plastics with clear vinyl windows.

Monsanto Schedules Expansion

Plans for doubling the production of Opalon PVC polymers and copolymers have been announced by Monsanto Chemical Co.'s plastics division, Springfield, Mass. Construction of new facilities in Springfield will begin immediately, with production scheduled for early next year.

Recent end-use developments, such as vinyl flooring, phonograph records, wire and cable insulation, and paste resin applications, have bolstered the company's position as a supplier, according to Monsanto spokesmen, and additional resin requirements are anticipated for these uses.

Molds Complex Throat Liner

A refrigerator throat liner, produced in a two-cavity, 33-ounce shot resembling the letter "H," has been molded by Michigan Plastic Products, Inc., Grand Haven, Mich., using a 600T-32 oz. Reed-Prentice injection machine.

The mold weighs 6,400 pounds and extends six inches beyond each side of the 54-inch wide platen. Design of the machine, with six-inch tie bars and sliding support shoes for the movable platen, permits the handling of such large loads. The machine's high plasticizing capacity and fast plunger speed reportedly solves the problem of conveying the plasticized high-impact styrene material to all parts of the mold cavity. In addition, the positive mechanical mold clamping pressure of 600 tons is said to keep flash at a minimum.

Koppers To Build New Lab

A development laboratory, consisting of three buildings connected in a U-shape and covering 43,000 square feet, has been scheduled for construction by Koppers Co., Inc., adjacent to the newly-opened plant at Kobuta, Pa. The main building, which will be completely air conditioned, will consist of two stories and a basement measuring 50 by 178 feet. The two wings will be of one-story construction, each 74 by 114 feet.

The new unit, to be completed early in 1956, will test and develop for application the products formulated at Koppers' Verona, Pa., research center. Projects will be undertaken under the auspices of Koppers' chemical division, and will include plastics application studies in the fields of mechanical processing, protective coatings, analysis, control, and physical testing.

Operator Removing Two-Cavity Shot of Refrigerator Throat Liner from 600T-32 oz. Injection Molding Machine

Vinyl-Lined Plating Machine

Over 20,000 square feet of B. F. Goodrich's Koroseal vinyl sheeting have been used to line the steel tank walls of Pontiac Motor Division's new bumper-plating machine, now in operation at the Pontiac, Mich. plant. The flexible plastic material prevents acid corrosion with subsequent contamination of the plating solutions. According to Goodrich, Koroseal has high resistance to certain strong oxidizing acids which cannot be handled with rubber.

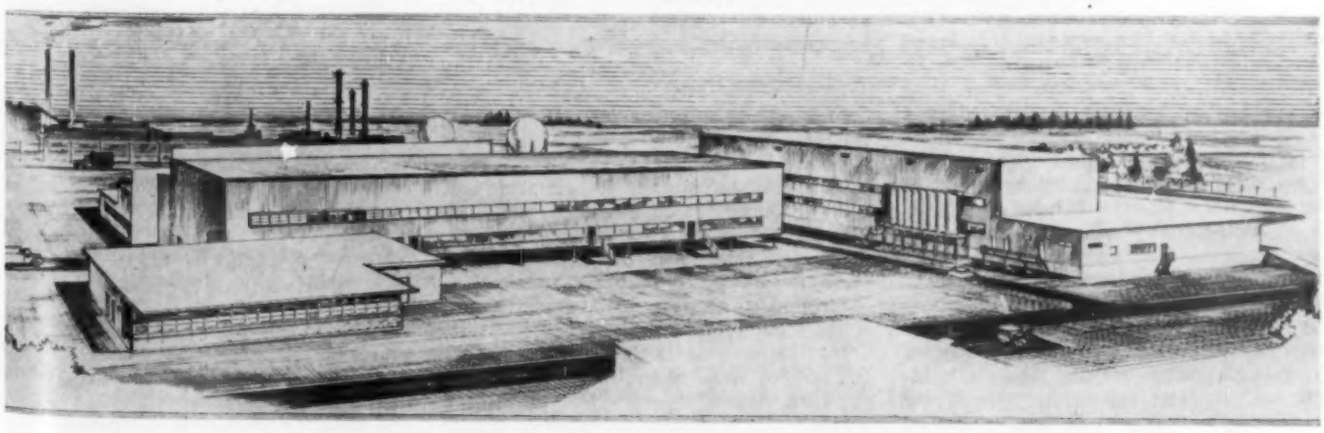
Udylite Corp., Detroit, Mich., manufactured the 460-foot-long machine, which is designed to turn out 360 chrome plated bumpers per hour. It contains 34 tanks, the four largest having a capacity of 24,000 gallons each. The two-hour plating cycle consists of 37 operations, including cleaning, spraying, washing, rinsing, dipping, and plating. The actual procedure involves the deposit of 0.0007-inch copper and 0.0008-inch nickel layers and, finally, the chrome finish.

Production Started at Tuscola Petrothene Polyethylene Plant

National Petro-Chemicals Corp., New York, N. Y., a joint enterprise of National Distillers Products Corp. and Panhandle Eastern Pipeline Co., has announced the opening of their 26 million-pound per year polyethylene plant at Tuscola, Ill. The resins, trademarked "Petrothene," are available through the sales facilities of U. S. Industrial Chemicals Co., a division of National Distillers.

Petrothene is produced by a modified ICI process from highly purified ethylene, which, with its precursors, is also produced at the Tuscola plant by an upgrading of natural gas hydrocarbons. The process pattern may be outlined as follows: natural gas from Panhandle's compressor station is pumped through an extraction unit to remove the hydrocarbons which are liquefied and fractionated; the ethane fraction is heated to 1500° F. for conversion into hydrogen and ethylene; and the latter is purified and fed into the polyethylene unit.

A polyethylene applications section has been established at the plant laboratory for customer technical service. Laboratory facilities have been doubled within the last year to accommodate this group and the control section. Petrothene pellets are packaged to 50-pound multiwall bags, in grades suitable for extrusion, compression, and injection molding. Warehouses have been set up at Chicago, Ill.; Newark, N. J.; and Anaheim, Calif.



Artist's Drawings of National Petrochemicals' New Polyethylene Plant at Tuscola, Ill.

Rigid Vinyl Pipe Being Used to Convey Vinegar from Storage Vats

Vinegar-Resistant PVC Pipe

Rigid vinyl pipe has replaced the expensive stainless steel piping formerly used by the H. W. Madison Co., Medina, O., to convey vinegar and sugar water for use in the processing of Dolly Madison pickles and mayonnaise. The piping is fabricated by Colonial Plastics, Cleveland, O., from B. F. Goodrich Chemical Co.'s Geon vinyl resin.

Newly activated vinegar is conducted through a filter to a vat where it is mixed with alcohol, bacteria food, and water. Pumps force the mixture into a generator where it filters through a bacteria medium of beechwood shavings which transforms it into 100-grain vinegar. The vinyl pipe and fittings used in these operations are reportedly resistant to scale formation and acetic acid corrosion, even at the high temperatures required.

Argus Installs Reactor Kettle

A 3,500-gallon glass-lined kettle designed to operate at temperatures up to 550° F., the reaction temperature in the manufacture of heat and light stabilizers for PVC, has been installed by Argus Chemical Corp., Brooklyn, N. Y. The automatic pressureless high temperature system was engineered by American Hydrotherm Corp., and utilizes Monsanto's Aroclor 1248 heat-transfer fluid for both heating and cooling operations.

Although temperatures range from 75-550° F. during the heating and cooling periods, the heat differential between the kettle contents and the Aroclor reportedly never exceeds 175° F., thus preventing damage to the glass lining.

An International-LaMont forced circulation heater, fired by a dual type burner for either natural gas or fuel oil, supplies three-million Btu. per hour. A water-cooled centrifugal pump circulates the heat transfer fluid through agitator nozzles in the jacket of the reactor, affording controlled batch heating.

Plastics at I. R. E. Show

Over 40,000 radio engineers and scientists attended the annual convention sponsored by the Institute of Radio Engineers and held March 21-24 at the Waldorf Astoria Hotel, Belmont Plaza, Kingsbridge Armory, and Kingsbridge Palace. Largest of its kind, the convention featured the presentation of 275 papers at 55 technical sessions and an engineering show comprising 704 exhibits.

A number of new plastic applications were on display, and plastic materials played a large role in much of the standard equipment. Porous Fiberfilm, produced by American Machine & Foundry Co. by blending Teflon and micro-fiberglass, was introduced as a wire and cable wrapping, a coil inter-layer insulation, and a component in transformers and condensors. Warren Wire Co. presented Teflon-coated glass fabric and tapes. Resinite Vinyl Glass for electrical insulation sleeving was shown for the first time by Resin Industries, Inc. Also on display was Du Pont's Mylar polyester film.

Other items featuring plastic construction included Taylor Fibre Co.'s cold-punching phenolic laminates; American Phenolic Corp.'s Polyfluoron coated copper wire; nylon-coated toroidal coils and filters by Communications Accessories Co.; a vinyl-jacketed handle and mounting plate by Radio Frequency Laboratories, Inc.; Chester Cable Corp.'s Plasticord-Plasticote wires and cables; a trimmer capacitor with a self-lubricating nylon bushing, developed by Corning Glass Works; numerous plastic embedments, lenses, foams, and castings by Emerson and Cuming, Inc.; a microwave absorber of phenolic and styrene foams from McMillan Industrial Corp.

Polyethylene Pipe Water Mains

More than 4,800 feet of polyethylene pipe are being used to convey the entire water supply for the town of Frelighsburg, Que., Canada, replacing the old, corroded water mains of galvanized iron and copper piping. Heavy-duty Carlon pipe, supplied by Beardmore & Co., Ltd., and capable of withstanding pressures of 75 psi., was chosen for the job.

Source of the town's supply is a hillside spring feeding a 25,000-gallon reservoir. A 30-foot drop from source to reservoir and an additional 160-foot incline to the town level furnish sufficient gravity to force the water into the service outlets and pumping apparatus. Two-inch pipe was selected to connect spring and reservoir, 1½-inch pipe for the main supply lines, and ¾-inch pipe for entry lines to buildings.

Accelerated weathering tests indicate that polyethylene pipe, compounded with carbon black for protection against sunlight, has a life expectancy of about 30 years when fully exposed to the elements. Underground service should be much longer if the pipe is buried below the frost line.

Installation was accomplished by only three men, since a five-foot harrow was sufficient except at entry lines from the main, where manual installation of plastic tee-reducers was required.

In Brief . . .

Koppers Co., Inc., has announced the formation of a company-wide marketing department under the direction of Ralph Winslow, company vice president. The new department will embrace the functions now divided between the central sales staff and the public relations department, including sales management, market and economic research, sales personnel development, sales promotion, advertising, and public relations.

Wheelco Instruments Division, Barber-Colman Co., Rockford, Ill., has named R. H. Wittbold Co. and Swieco Inc., as their exclusive sales representatives in the Houston and Fort Worth, Tex., areas, respectively.

Dow Chemical Co., Midland, Mich., has announced that the following departmental sections have attained the 3-million man-hour safety mark without a lost-time accident: plastics technical service, coatings technical service, textile technical service, sales, plastics IBM tabulating, Styron warehouse, and plastics management.

Celanese Corp. of America, New York, N. Y., has acquired a 114-acre tract of land in Charlotte, N. C., for the erection of new development laboratories which will serve as a link between the firm's fiber research laboratories in Summit, N. J., and commercial fiber plants. The first sectional unit is scheduled for completion in 1955.

Celanese Corp. of America, New York, N. Y., has announced an accident frequency rate of 1.57 lost-time accidents for every million man-hours worked in all their manufacturing plants and research facilities, as compared to the national average of 7.44.

Canadian General Electric Co., Ltd., Toronto,, Ont., has awarded a record $27,000 for 1,761 useful suggestions submitted by employes during 1954. Largest number of suggestions per 100 employes was submitted in the company's plastics plant in Cobourg, where the ratio was 148 per 100 workers, and the acceptance ratio 68 per 100.

United States Rubber Co., New York, N.Y., has agreed with the Federal Trade Commission not to use the name "Naugahyde" to describe its vinyl-coated fabric without specifying that the product is not leather.

American Cyanamid Co., New York, N. Y., paid out a total of $88,649 for employe suggestions during 1954. From the 24,443 ideas submitted, 5,690 were adopted for use by the firm. The over-all company average was 114 suggestions per 100 employes.

Plastics division, Monsanto Chemical Co., Springfield, Mass., has available a new, short color film entitled "Chain Cooking," which demonstrates proper wrapping and refrigeration storage of food with styrene plastic containers.

News from Abroad

Polystyrene Models for Precision Casting of Metal Parts

The use of polystyrene in place of wax in the production of metal parts by investment casting has been found to give good results in Germany. As applied to the manufacture of small parts, the process begins with the molding of polystyrene patterns from a carefully prepared steel die. The individual plastic models are then assembled in tree-like clusters with the aid of a heated tool and wax or synthetic resin, and the assembled models provided with a very thin fireproof coating by dipping or spraying. The coated models are immediately dusted with coarse sand.

After drying, the coated models are arranged on perforated plates, and the assembly enclosed in a cylindrical forming box and filled in with filler compound. The choice of the filler compound depends on the casting temperature of the metals to be used. The filled forms are then dried and heated in electric ovens at a temperature sufficiently high to melt the polystyrene, which is drained off via the perforated plates. As soon as the forms, free of plastic, are removed from the oven, they are ready for the metal-pouring process. The high degree of accuracy in reproduction obtained in the metal casting is said to be due largely to the use of the plastic models.

Tropic Tests on Polyethylene

Results of experiments on the behavior of polyethylene in the tropics, carried out in Nigeria, West Africa, and in the United Kingdom, indicate that the material is less affected by the moisture of tropical climates than by the tropical sun in jungle clearings and, more particularly, on the beach and in the desert.

The tests were carried out over a period of 12 months on two grades of British polyethylene, Alkathene 7 and Alkathene 20, both containing 0.1% anti-oxidant, while some samples also included 0.1% carbon black. No difference in the performance of the two grades was observed; in practically all cases, however, adverse effects were greatly reduced by the presence of carbon black. Thus, samples without carbon black exposed for 12 months in jungle undergrowth had a green coloration, while those containing carbon black were unaffected. In a jungle clearing, however, even specimens protected by carbon black had isolated spots of green fungus after six months.

Electrical property tests on specimens in jungle undergrowth indicated that neither resistivity nor power factor was much affected; without carbon black, there was considerable deterioration. In semi-desert and surf-beach sites, even carbon black did not provide protection for more than six months; under the worst conditions of the test, there was a 30-fold rise in power factor without carbon black, and a 10-fold rise with black.

Continuous exposure to the tropical sun resulted in surface cracking, increased brittleness, loss of flexibility and extensibility, and a rise in cold bend temperature. Progressive loss in specimen weight was noted at all sites, even after only three months.

It is concluded from these results that while carbon black is helpful and should be included in polyethylene for use in the tropics, additional protection will have to be provided if more than limited service in direct sunlight is desired.

Mortar-Set Wall Tiles

An obstacle in the way of increased use of polystyrene wall tiles was found to be the reluctance of French consumers of tile to depart from their usual working methods. Many refused to try the polystyrene tiles as soon as they discovered they would have to use a special adhesive instead of the customary mortar.

This difficulty is now said to have been solved by making the tiles with a series of truncated studs placed about 10 millimeters apart along the periphery of the tile. The tiles can then be set in mortar in the usual way for ceramic tiles. The studs are held in the mortar by a very strong suction effect, and the tiles will not pull off as long as the studs are thoroughly embedded in the mortar. Tiles set in bathrooms and showers by this method, which was first patented in Morocco, are claimed to be perfectly intact after three years.

Gummiwerk Expands Plastics Line

Gummiwerk Odenwald G.m.b.H., with main offices in Frankfurt a. M., Germany, has announced increased production in their newly acquired plastics department. Polyethylene, under the trade name Ylopan, is being manufactured in film and tubular form. A special fabricating and printing department has been set up to supply bags and heat sealed covers to specification.

Jakob Hirschberger, executive director and major shareholder of Gummiwerk Odenwald, is also president of Rotex Rubber Co., Inc., and Alpha Chemical & Plastics Corp., Newark, N. J.

New Molding Compound

Fibresinol, a phenolic molding compound with a special kind of artificial fiber as filler, is being put out by the chemische Fabrik Dr. F. Raschig, G.m.b.H., Germany. Intended for the production of parts with high mechanical strength, it can be used successfully in transfer molding operations where particularly uniform, thin-walled parts are desired, as well as for parts with sharp contours. Some of the physical properties of Fibresinol are: bending strength; 820-1,135 kg./sq.cm.; impact strength; 23-34 cm.-kg.; notched bar impact, 20-38 cm.-kg.; sp.gr., 1.39; and dimensional stability (Martens), 143-164° C.

Loose Polyethylene Linings

Loose polyethylene inserts with feed connection sand screw tops for use in vats, tanks, barrels, and cartons have recently been patented in Germany. The inserts are made of polyethylene tubing with welded circular tops and bottoms. The top part is provided with a feed socket, also of polyethylene, about the size of a bung-hole for a barrel, and a screw top of polyethylene or rigid PVC. If required, an attachment can be welded to the top or bottom of the liner for firm anchorage to the barrel.

Similar inserts are available for smaller paste-board containers, such as quart sizes. These inserts have round or rectangular tops and bottoms, and feed sockets about the size of a bottle neck. For containers to hold powdered substances, liners are supplied with a polyethylene feed tube which can be made in any dimension desired, and which is closed off after the receptacle is filled. By this means, it is claimed, all stresses in the insert are avoided even if it is filled to the brim.

Dusseldorf Plastics Fair

The second Plastics Trade Fair and Production Exhibition will be held in Dusseldorf, Germany, on October 16-31. While the plastics and plastic products shown will be of German origin, it is planned to arrange the machinery section to include international participation.

The German plastics industry has continued to progress rapidly, and in 1953 produced 240,000 tons, against 191,000 tons in 1952. In the first quarter of 1954, output rose by 60% (from 50,000 to 80,000 tons) over the corresponding period of 1953. At the same time the range of plastics offered has been extended and now includes every type made abroad.

The value of the output of the German plastics processing industry rose from 451,-100,000 DM. in 1952, to 553,000,000 DM. in 1953, and there has been a small, but regular increase in exports of these goods. Exports of machinery for the rubber and plastics industries also advanced markedly. Taking 1950 as equal to 100%, the values for 1952 and 1953 came to 250% and 320%, respectively.

German Plastics Institute

The Institute for Plastics Chemistry and Technology, which was established in Leipzig, East Germany, about the middle of last year, is under the control of the Ministry for Heavy Industries. Departments have been set up for: (1) general and physical chemistry and physics; (2) preparative and analytical macromolecular chemistry; (3) processing techniques and technological application of plastics and plastics raw materials; and (4) industrial application and advice. Director of the Institute is Dr. Kurt Thinius, formerly head of the Magdeburg Institute.

Part of the task of the advisory department will be to familiarize the various branches of the plastics industry with the newest applications and methods, and consulting engineers will be on hand to give advice and guidance. At present, special attention is being paid to the problems connected with the increased use of plastics in shipbuilding and in vehicles for rail and street traffic. Standardization of parts in these applications is another aim.

At a meeting of the Institute held September 28-29, 1954, representatives of the plastics and shipbuilding industries discussed the various ways in which plastics could be used to increase safety, reduce weight, or replace non-ferrous metals which are in short supply. Typical applications include non-flammable PVC and Perlon fiber fabrics for drapes, upholstery, and mattress coverings; foamed PVC in lifebelts; and PVC foam and veneers for furniture, insulation, and other paneling. Much interest was shown in panels of Glakresit, a new product of fiber glass bonded with cresylic resin, which is noninflammable and corrosion resistant. When covered with suitable veneers, this product makes lightweight, attractive, and inexpensive panels.

Chemical & Plastics Show, Paris

The Plastics Division of the Third Chemical and Plastics Show, held in Paris, France, on December 3-12, 1954, offered a wide variety of exhibits from all sections of the industry—machinery and tools, materials, testing apparatus, and finished goods.

In addition to French manufacturers of machinery, American, British, German, Italian, and Swiss firms also were represented. All types of machinery were shown with emphasis on injection molding and vacuum forming equipment. Both horizontal and vertical injection molding machines were displayed, in capacities ranging from 12-2,000 grams. Among the American machines were Watson-Stillman horizontal and vertical units, and the new Reed-Prentice Type 175 T made in France by Etablissements Herbert under license from Reed-Prentice. Newsworthy was the number of machines of Italian design, some made in France under license and some imported. In this group, F.I.M.S.A.I. showed a high capacity injection machine fed by hydraulic units, including pump and accumulator, which can be used to service several different models at the same time; and Triulzi displayed a new 600-gram automatic press.

Among the vacuum-forming machines were the Vuotoplast, made in France by S.E.F. under license from Negri Bossi; and a new version of the universal machine made by Etablissements Eynard for injection, transfer and compression molding, which also permits vacuum forming and blow extrusion. The American Autovac unit and new models of the Swiss Formvac were also on view.

A large, twin-screw extruder for compounding and extruding rigid PVC was the attraction at the exhibit of Etablissements Trudex. This machine, of French design, has a capacity of up to 120 kgs. per hour of rigid PVC. The screw ends are shaped to provide very intensive kneading action on the material, and frictional heat is counteracted by internal cooling of the screws. The machine has five heating zones, of which the three in the cylinder are water-cooled.

The firm of J. Facon demonstrated the working of an automatic injection molding press which it manufactures under license from the Battenfeld concern, in Germany. The French company has developed an effective yet simple safety device for this machine to prevent serious accidents to hands and fingers caught between the mold sections during the closing process. The mold half at the injection cylinder side is adjustably supported on ball-bearings in the cross rails to permit a displacement of 50-100 mm. The pressure required for such displacement is only about 100 gms. for smaller machines and, even in the case of large presses, is said to be so low as to preclude the possibility of serious iinjury resulting to hands and fingers caught between the mold sections. At the same time the mold closing process stops automatically if anything at all, even a cleaning rag, comes between the mold halves.

The materials displays bore witness to the growing interest in France of reinforced polyester resins. Several of the leading concerns featured their use in car bodies, boats, roofing, paneling, etc.

British Plastics Exhibition

The third biennial British Plastics Exhibition and Convention is scheduled to be held at the Olympia in London, England, from June 1-11, 1955. Nearly 100 exhibitors, including all the best known firms in British industry, will show the latest materials, moldings, and fabricated goods in a display covering over 54,000 square feet.

The convention program as announced will include 12 sessions on the following subjects: Polymer Structure and Properties (two sessions); Expanded Plastics; Thermoplastics; Extrusion; Works Study; Injection Molding (two sessions); Patents; Foundry Resins; and Glass-Reinforced Plastics (two sessions).

The British plastics industry annually spends about £5 million on research and development. The 1954 output shows a 30% increase over last year and exports are up 25%. Many of the results of work done since the 1953 show will be apparent both in the exhibition and in the papers read before the convention.

The exhibition is organized by the journal, "British Plastics", Stamford St., London, S. E. 1., with the full cooperation of the British Plastics Federation. Full particulars are obtainable at the offices of Thomas Cook & Sons, Travel Agents, or B.O.A.C. Admission is free.

In Brief . . . .

The Compagnie de Saint-Gobain, Paris, France, has recently begun to produce polyester resins in accordance with American Cyanamid Co. patents. These Stratyl resins for contact or low pressure use are sold as transparent, almost colorless liquids in a range of viscosities.

Rhone Poulenc, Paris, France, is marketing a new cellulose acetate molding powder, Rhodialite. The material is said to be non-flammable and have improved resilience and dimensional stability.

The Societe Ethylene-Plastique at Mazingarbe, Pas de Calais, France, is making Plastylene, the first French polyethylene, under license from Imperial Chemical Industries, Ltd.

Dynamit A. G., vorm. Alfred Nobel & Co., Germany, has buitl a new unit at its Troisdorf works for the polymerization of vinyl chloride produced at the concern's Rheinfelder Works.

Chemische Werke Huls. A. G., Germany, is expanding facilities for manufacturing PVC, polystyrene and other plastics, as well as intermediate materials for synthetic fibers and plasticizers.

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NAMES in the NEWS

John W. Stevens

John W. Stevens has been appointed vice president in charge of sales for Reichhold Chemicals, Inc., White Plains, N. Y. Formerly general sales manager of Celanese Corp., he will direct sales to major consumers of industrial chemicals, as well as to firms in the plastic, surface coating, textile, foundry, and plywood industries.

Burton S. Marks has been assigned to the plastics and resins group in the research and development department of Hooker Electrochemical Co., Niagara Falls, N. Y.

Carmen La Monte has been appointed general manager of the enlarged vacuum forming division of J. B. Carroll Co., Chicago, Ill. He has an extensive background in the vacuum forming industry, having served as plant manager for L. A. Goodman Mfg. Co. and Stanley Wessel & Co., and most recently as a consulting engineer.

Carmen La Monte

J. L. McCurdy

J. L. McCurdy has been appointed assistant manager of the plastics production department, Dow Chemical Co., Midland, Mich. He will be in charge of Styron, saran, Ethocel, vinyl toluene, and PVC operations at the Midland division. **Daniel W. Ryan,** formerly production superintendent, becomes manager of the Styron plant in Torrance, Calif., succeeding **Dr. McCurdy.**

John R. L. Johnson, Jr., director of the legal department and member of the board of directors of Hercules Powder Co., Wilmington, Del., has been elected a member of the finance committee. Reelected to the finance committee were **Edward B. Morrow,** vice president and committee chairman; **Albert E. Forster,** president; and **John E. Goodman,** treasurer.

Gilbert Thiessen

Gilbert Thiessen has been appointed assistant manager of the research department for Koppers Co., Inc., Pittsburgh, Pa. Prior to this appointment **Dr. Thiessen** had served as manager of the chemical division's development section, technical advisor for the division, and more recently as manager of the research department's laboratory section. **E. E. Donath** was selected for the newly created position of manager, technical appraisal and planning section. In addition to these duties **Dr. Donath** will continue as manager of the fuels processing section.

L. L. Shailer, Sr., has been named product engineer in charge of sales development of hydrophilic polymers for the general chemicals sales department of B. F. Goodrich Chemical Co., Cleveland, O. **R. E. Score, Sr.,** will perform the same functions with reference to surfactants. Both men have served as technical service engineers and as sales representatives for the company.

Charles O. Koch has been appointed technical service superintendent for Mobay Chemical Co.'s new isocyanate plant at New Martinsville, W. Va. He has been associated with Monsanto's research and engineering division, assisting in the design of the Mobay plant. His new duties will include responsibility for technical services to the production department and for materials handling.

William J. Leighton has been appointed sales engineer for the Philadelphia district office of F. J. Stokes Machine Co., Philadelphia, Pa. He formerly served with the sales staff of Conoflow Corp., Philadelphia instrument and valve manufacturers.

R. C. Boltz and **G. E. Kuehn** have been named sales managers of the Newark and Buffalo districts, respectively, for Carbide & Carbon Chemicals Co., New York, N. Y. **G. S. Cooper, J. W. Locher,** and **B. W. Hurley** have been transferred to the New York, Pittsburgh, and Indianapolis sales districts, respectively.

Edward R. Tolles

Edward R. Tolles has been appointed sales manager for the Ultron vinyl film and sheeting department, Monsanto Chemical Co., Springfield, Mass. He joined Monsanto in 1942, and has served successively as research chemist, technical service and sales representative, and assistant sales manager.

Cooke Bausman, Jr., former sales department manager, was named assistant to the general manager of the chemical division, and more recently assistant vice president of Koppers Co., Inc., Pittsburgh, Pa. **George W. Naylor** was chosen as manager of the chemical division's international department. He formerly served as assistant sales manager of Koppers' tar products division.

Clyde A. Case has been named central manager of the pigment, color, and chemical division of The Sherwin-Williams Co., Cleveland, O.

Louis F. Weyand has been named sales director of Minnesota Mining & Mfg. Co., St. Paul, Minn., succeeding **George H. Halpin** who will remain active as a consultant. Both men are executive vice presidents and directors of the firm. **Mr. Weyand** joined the company in 1915.

Thomas A. DeMarco has been appointed manager of the newly established industrial applications department of Monsanto Chemical Co.'s plastics division in Springfield, Mass. Formerly sales engineer in the product development department, **Mr. DeMarco's** new duties will include aiding manufacturers in plastics materials specification and determining new product demand.

V. E. Atkins

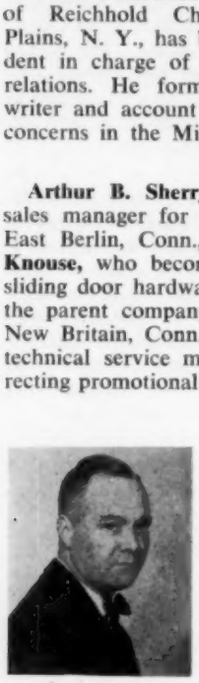
Thomas A. DeMarco

V. E. Atkins has been named general manager of the organic chemicals division, American Cyanamid Co., New York, N. Y. He formerly served as manager of manufacturing for Cyanamid's Calco Division, and as assistant to **L. C. Duncan,** whom he replaces. **Mr. Duncan** becomes general manager of the company's Lederle Laboratories Division. **D. M. Benjamin,** former executive director of Lederle, has been appointed assistant general manager.

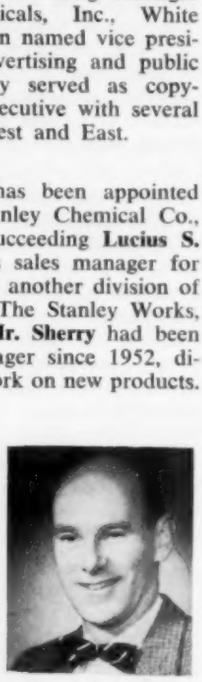
Paul C. Panagiotakos has been appointed director of sales for National Polychemicals, Inc., Wilmington, Mass. He formerly served as chief chemist of New England Tape Co., Inc., and was also associated with Dewey & Almy Chemical Co.

Mark Pinkerman, advertising manager of Reichhold Chemicals, Inc., White Plains, N. Y., has been named vice president in charge of advertising and public relations. He formerly served as copywriter and account executive with several concerns in the Midwest and East.

Arthur B. Sherry has been appointed sales manager for Stanley Chemical Co., East Berlin, Conn., succeeding **Lucius S. Knouse,** who becomes sales manager for sliding door hardware, another division of the parent company, The Stanley Works, New Britain, Conn. **Mr. Sherry** had been technical service manager since 1952, directing promotional work on new products.



Arthur B. Sherry



Clinton A. Braidwood

Clinton A. Braidwood has been appointed to the newly created post of director of development for Schenectady resins division, Schenectady Varnish Co., Inc., Schenectady, N. Y. He has served as assistant director of research since 1952.

Herbert D. Stuber, former superintendent of Dow Chemical Co.'s saran rubber department, has opened sales offices in Indianapolis, Ind., to represent Saran Lined Pipe Co., Ferndale, Mich. He will service firms requiring corrosion-resistant linings for process equipment throughout Indiana, Kentucky, and parts of Illinois and Ohio. **Cyrus C. Perkins,** saran development engineer, replaces Mr. Stuber.

Richard F. Cassidy has been appointed production superintendent for Mobay Chemical Co.'s New Martinsville, W. Va. plant. He previously served as production supervisor for Monsanto's plant in Nitro, W. Va. and as department and manufacturing superintendent at Monsanto's Everett, Mass., installation.

Henry N. Marsh, smokeless powder consultant to the explosives department of Hercules Powder Co., Wilmington, Del., and the firm's advisor on civilian and military matters, has been granted a year's leave of absence to serve as Deputy Assistant Secretary of the Army in logistics and in research and development.

Orwin G. Maxson

Louis E. Tallman

E. E. Merrill

Dow Chemical Co., Midland, Mich., has announced the following promotions in the plastics technical service department:

Louis E. Tallman as head of the Western section with headquarters in Los Angeles, Calif. He has been handling PTS service on the West Coast since 1950, with emphasis on injection molding, and will now broaden his scope to include films, foam, sheetings, and extrusion.

E. E. Merrill as head of the Eastern section with headquarters in Allyn's Point, Conn. He will handle development and customer service in New England for Styron and Styrofoam.

Orwin G. Maxson as assistant to Mr. **Tallman.** He formerly served in the molding section of the PTS laboratories.

Emery Parker has been appointed director of research for the plastics division of Advance Solvents & Chemical Corp., New York, N. Y. **Dr. Parker** has been engaged since 1944 in research and development of polymeric organo-metallic stabilizers for the vinyl plastic field. **John F. Herrmann** was named manager of plastics field service. He formerly served with Dow Chemical Co., Goodyear Tire & Rubber Co., and Sunlite Plastics.

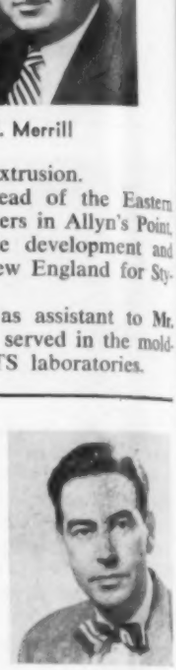
Three new men were elected to the board of directors of American Wheelabrator & Equipment Corp., Mishawaka, Ind.; **Leslie L. Andrus,** vice president in charge of sales and executive head of the dust and fume control division; **Harold M. Miller,** corporation vice president; and **Ray P. Whitman,** first vice president of Bell Aircraft Corp. **Verne E. Minich,** founder of American Wheelabrator, remains chairman of its 15-man board.

J. Frank Taylor has been appointed midwest district manager for Federal Color Laboratories, Inc., Cincinnati, O., with offices in Northlake, Ill., a Chicago suburb. He was previously associated with Commercial Solvents Corp. and Chicago Copper & Chemical Co. in executive sales capacities.

W. F. Munnikhuysen

Fred C. Foy

W. F. Munnikhuysen was elected chairman of the board, and **Fred C. Foy** was named president and chief executive officer of Koppers Co., Inc., Pittsburgh, Pa. **Mr. Munnikhuysen** has been executive vice president of Koppers since 1950. **Mr. Foy,** formerly vice president and general manager of the company's tar products division, is succeeded by **R. R. Holmes.**



Frederick H. Roberts

Frederick H. Roberts has been appointed director of research for Bakelite Co., New York, N. Y., with headquarters at the Bloomfield, N. J., laboratories. **Dr. Roberts** formerly served as director of the plant laboratories for Carbide & Carbon Chemical Co., another division of Union Carbide.

Robert J. Considine has been elected president of San Diego County Industries, Inc., an area-wide association of manufacturers, processors, fabricators, and allied industries. He is currently employed as product and development engineer in the translucent fiberglass panel department of Chemiglas, Inc., a subsidiary of Alsynite Co. of America, San Diego, Calif.

OBITUARY

Boyd H. Carr, Sr.

Boyd H. Carr, Sr., 67, former head of pricing and chief statistician for Dow Chemical Co., Midland, Mich., died March 1 at Tucson, Ariz., where he and Mrs. Carr were spending the winter.

A native of Albany, N. Y., Mr. Carr was educated at Clarkston College of Technology, Potsdam, N. Y., and at the time of his death was a member of its governing board.

Joining the Dow organization in 1915, he served in a number of capacities including production, standards, and accounting. He retired in 1953 following three years service as special representative in Argentina and Uruguay.

A memorial service for Mr. Carr was held in Midland on March 8, followed by interment in Saginaw, Mich.

New Materials

Dibutyl Fumarate Monomer

Dibutyl fumarate, an essentially colorless liquid reactive resin and chemical intermediate, is now available in development or semi-commercial quantities from Monsanto Chemical Co., St. Louis, Mo. A monomer, it can homopolymerize as well as form copolymers with other monomers. Under adjusted conditions these polymers range from brittle resins to soft, internally plasticized materials.

Copolymers with vinyl acetate, vinyl chloride, acrylates, and styrene are of special interest in the formulation of surface coatings, free films, permanently tacky adhesives, fibers, synthetic lubricants, and additive agents for oils. As a chemical intermediate, dibutyl fumarate yields substituted succinates with the addition of halogens, aldehydes, thiols, and similar compounds. It also undergoes the Diels-Alder reaction with conjugated dienes.

Many additional miscellaneous reactions, toxicity reports, and a patent bibliography are included in the company's technical bulletin No. ODB-54-18. Physical properties are reported as follows:

Color, APHA	25
Refractive index at 25°C.	1.4446
Specific gravity, 25°/25°C.	0.9843
Acidity, mg. KOH/g.	0.05
Crystallizing point, °C.	—18.9
Flash point (Cleveland open cup), °F.	275
Fire point (Cleveland open cup), °F.	300
Boiling points, approx., °C.:	
At 760 mm. Hg.	285
At 100 mm. Hg.	212
At 10 mm. Hg.	149
At 1 mm. Hg.	103

Clear Vinyl Cast Film

Bakelite Co., New York, N. Y., has announced the commercial availabilty of clear vinyl cast film and sheeting in thicknesses ranging from 5-10 mils. Designated Krene Cast Film, it reportedly combines high clarity with a tear strength of 480 grams per mil at room temperature.

The film is available in continuous 100-pound rolls up to 36 inches wide, and with tolerances within ±5% of a given thickness. Uniform thicknesses and controlled tensile strengths to 3,800 psi. are reportedly maintained, suggesting applications which require clarity and durability, in addition to use in glazing and packaging.

The material is cast on stainless steel belts in one continuous operation, producing a finish and clarity comparable to press-polished calendered sheets, but with greater economy. Tear strength is applicable both lengthwise and crosswise, unlike conventional calendered film.

Liquid Epoxy Curing Agent

A new curing agent for heat-resistant epoxy castings, laminates, adhesives, and structural members has been introduced by Aries Laboratories, Inc., New York, N. Y. Called Aritemp Curing Agent 105, it reportedly has longer pot life and lower exotherm temperature than obtainable with solid catalysts.

CA 105 is said to impart chemical resistance to epoxy resins, making them useful for chemical tank linings and corrosion resistant paints. A viscous black liquid, it should be heated to 35-55° C. to facilitate pouring and handling. Mixing proportions are 20-25 parts to 100 parts resin by weight. Pot life is four hours at room temperature, 45 minutes at 60° C.

For maximum heat distortion temperature, large castings should be allowed to stand at room temperature for 24 hours before curing for one hour at 100° C. Smaller castings require only two hours of conditioning, followed by a three-hour cure at 110° C. A post-cure at 175° C. for ½-hour insures maximum heat distortion point. Small pieces can be placed in the oven directly and cured for four hours at 110° C., followed by post cure.

Physical properties of a finished product, using 22 parts CA 105 with 100 parts Aritemp Resin 311, are as follows:

Heat distortion, °C.	150
Tensile strength, psi.	8,500
Modulus of elasticity, psi.:	
At 25° C.	500,000
At 135° C.	260,000
Flexural strength, psi.	21,000
Compression strength, psi.	19,000
Impact strength, Izod, ft.-lbs./in.	0.6
Power factor, 60 cycles:	
At 25° C.	0.005
At 135° C.	0.012
Coefficient of thermal expansion	5×10^{-5}

Laminates with 181 glass cloth, Volan A finish, gave flexural strengths of 75,000 psi. at 25° C., and 60,000 psi. at 150° C.

Metalead Bronze Powder

A new solvent-free powdered bronze containing approximately 1% stearic acid, 0.75% stearates, and the balance metallic lead in flake form, has been developed by Metalead Products Corp., Palo Alto, Calif. Designated Metalead Bronze, the material is used as a pigment in corrosion resistant primers for metallic surfaces where mineral spirits are undesirable. It is reportedly very effective in vinyl resin coatings. Additional information is not presently available, except through the company's technical service department.

Hydrophobic Kaolin—ASP1300

Kaolin treated with a surface active agent to give it water-resistant characteristics has been placed on the market by Minerals & Chemicals Corp. of America, Metuchen, N. J. Called ASP 1300, the material also has low absorption, is easily dispersed in organic systems, and is expected to find application in the paint, rubber, ink, and reinforced plastics industries. As a class, kaolins are normally hydrophilic.

ASP 1300 is of fine particle size distribution, is water-washed and water-fractionated. Treatment with the surface-active agent gives it improved wet-out, reduced viscosity, low mixing time, and a minimum tendency to agglomerate—ideal attributes for use with organic systems, the company says.

Significant data on the material is as follows:

Particle size average, microns	0.55
Oil absorption (ASTM D281-31)	31-32
Maximum moisture, %	1.0
pH (TAPPI Tentative Standard T 645 m-54)	6.5-7.5
Color (brightness), minimum %	85.5
Specific gravity	2.58
Particle size distribution, % by weight:	
0-½ micron	44
½-1 micron	28
1-2 microns	20
2-5 microns	8

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MArket 4-4444

Cabflex Tricresyl Phosphate

The commercial availability of Cabflex TCP, a tricresyl phosphate derived from petroleum cresylic acid, has been announced by the plastics chemicals division of Godfrey L. Cabot, Inc., Boston, Mass. The twelfth plasticizer to be introduced by Cabot, TCP was specifically developed for the manufacture of wire vinyl insulation and, in combination with the company's di-decyl phthalate, has been approved by Underwriters' Laboratories, Inc., for use in both 80° C. and 90° C. applications.

Mixed tank truck and tank car quantities of Cabflex TCP and DDP are available for all types of high temperature wire vinyl insulation compounds. Property data on TCP are listed as follows:

Molecular weight, average	400
Specific gravity at 20° C.	1.143-1.147
Pounds per gal at 20° C.	9.5
Max. volatility (6 hrs. at 100° C.), %	0.1
Flash point (Tag open cup), °F.	423
Boiling range at 10 mm Hg., °C.	265-285
Pour Point, °C.	—30
Refractive index at 25° C.	1.552
Acidity, %	0.01
Hydrolysis, 16 hrs. at 100° C.	Trace
Viscosity at 25° C., cps	109-133

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PX-120 Vinyl Plasticizer

A new vinyl plasticizer, developed for formulations requiring low volatility, low specific gravity, low temperature flexibility, and a high degree of permanence, has been introduced by the plasticizer division of Pittsburgh Coke & Chemical Co., Pittsburgh, Pa.

Designated PX-120, the new material is a diisodecyl phthalate derivative which also imparts viscosity stability to plastisols. Physical properties and specifications are listed as follows:

Molecular weight	446.7
Specific gravity, 25/25°C.	0.966
Boiling point, °C. at 5 mm. Hg.	255
Freezing point, °C.	—50
Flash point, °F.	450
Viscosity, 25°C., cps.	86
Refractive index, 25°C.	1.484
Color, A.P.H.A.	50
Max. acidity, as acetic acid, %	0.01
Min. ester content, %	99.0

Molded vinyl specimens, 50 and 20 mils thick, respectively, and containing 60 parts resin to 40 parts plasticizer, show the following mechanical properties and volatility characteristics according to ASTM test methods:

Ultimate tensile strength, psi.	2520
Ultimate elongation, %	380
Modulus at 100% elongation, psi.	1300
Hardness, Shore A	78
Tear strength, lbs./in.	430
Low temperature flex point, Clash-Berg T_f, °C.	—35
Oil extraction, 7 days, %	3.9
Gasoline extraction, 1 hr., %	23.4
Soapy water extraction, 24 hrs. at 60°C., %	0.3
Distilled water extraction, 7 days at 25°C., %	0.03

Vinyl Plastisol Wetting Agent

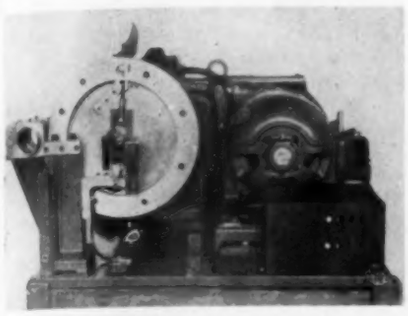
A new surfactant designed to reduce the viscosity and remove air bubbles from vinyl plastisol formulations has been introduced by Advance Solvents & Chemical Corp., New York, N. Y. Designated Advawet X-212, the new wetting agent is said to have particular application in plastisols having a low plasticizer-to-resin ratio and containing a large amount of fillers or pigments.

By reducing the interfacial tension between plasticizer and air bubbles, Advawet causes the bubbles to burst and reduces the tendency toward their formation during casting in the molds. Advawet is also reported to be effective in plastisols prepared with high viscosity or polymeric plasticizers.

Addition of 1-2% surfactant, based on the total weight of the plastisol, is recommended by the company. Material specifications are listed as follows:

Color, G.H.	1-2
Viscosity at 25°C., cps.	20-25
Specific gravity at 20°C.	0.984
Weight, lbs./gal.	8.2
Refractive index at 20°C.	1.4528

New Equipment



Foster-Allen Precision Cutter

Extrusion Cutter

A new electronically-controlled extrusion cutter that can handle plastic and rubber tubes and shapes up to 2¼ inches in diameter at a speed as high as 7,080 pieces per minute has been introduced by Foster-Allen Corp., Garwood, N. J. Called the Foster-Allen Precision Cutter, the machine provides a wide range of stepless increments from speeds of as low as one cut every 6½ minutes, with a cutting tolerance of ±.005 inches.

For speeds less than 150 cuts per minute, a retractable knife, pivoted near the rim of the flywheel and swinging in an arc, is used. Balanced around the pivot and operating on ball bearings, the design of the knife considerably reduces friction and centrifugal force, permits more rugged knife construction, and reduces the number of stops for lubrication and maintenance, the company reports.

For higher speeds fixed knives are attached to the flywheel. Regardless of cutting interval, the blade never travels less than 100 inches a second, thus obtaining square cuts, and avoiding backing-up of the material against the knife. Besides rubber and plastics, the machine handles soft wires, reinforced hose, impregnated fabrics, synthetic and natural fibers, and asbestos, and can cut multiple extrusions if these are fed to the knives by means of bushings.

Reed-Prentice Injection Molder

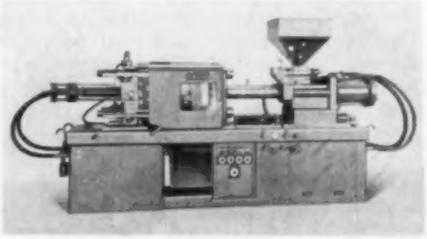
A new, high-speed, automatic injection molding machine, reportedly offering 175 tons positive mechanical mold clamping pressure in a six-second dry cycle, has been introduced by Reed-Prentice Corp., Worcester, Mass. Designated 175T-4/6 oz., the machine is said to offer such advanced design features as centralized controls, positive mold locking, high plasticizing and injection capacity, fully automatic operation, interlocked safety doors, and complete accessibility.

Four three-inch tie bars support the mold platens which measure 22 by 24½ inches, thus affording a projected casting area of 75 square inches. Molds up to 13 by 24½ inches are accommodated, and mold thicknesses accommodated range from 6-14 inches. Overall dimensions of the 8,200-pound unit are 189 by 33 by 80 inches.

The die stroke is adjustable between five and eight inches, and a built-in stuffing arrangement permits shots of six ounces or more through multiple strokes. The heating cylinder, which is equipped with ceramic heating elements, has a plasticizing capacity of 75 pounds per hour. Dual pyrometers control the heater temperature and the feed hopper holds a 200-pound plastic material drum at a 45° angle. Other specifications are listed as follows:

Injection pressure, psi.	19,000
Injection cylinder diameter, in.	8½
Injection plunger diameter, in.	2
Cycles/hour, max.	600
Motor, hp.	15
Heater, kw.	13.6
Oil reservoir capacity, gals.	80

Items listed as optional equipment include an automatic weigh-feeder, a low pressure die closing attachment, a nylon nozzle, and a die stop arrangement.



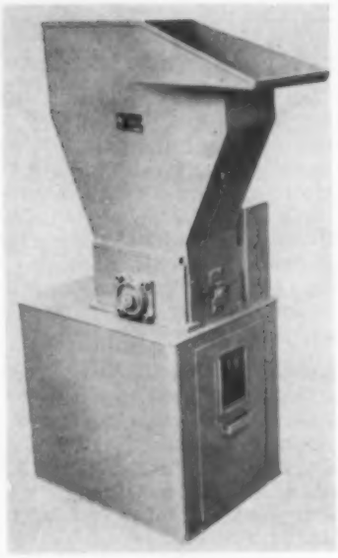
Reed-Prentice 175T-4/6 Automatic Hydraulic Plastic Injection Molding Machine.

All-Steel Plastics Grinder

The first in a line of all-steel granulators, to be known as the Marvel Series, has been introduced by Ball & Jewell, Inc., Brooklyn, N. Y. Designated M-100, it features a double shear knife action which reportedly grinds all plastics without fluffing at the rate of 200 pounds per hour.

M-100, a beside-the-press grinder with overall dimensions of 27 by 20 by 55 inches, has an 8- by 8-inch throat opening which accommodates rejects as well as sprues and runners. Hot and cold sprues can be fed simultaneously.

Other features include a hopper tray height of only 49 inches to facilitate feeding; the hopper itself being designed to eliminate fly back. Hopper and screen are detached in seconds, and fenders and shaft are combined in one unit for ease of cleaning. Hand clamps assure positive locking of the hopper at high speeds.



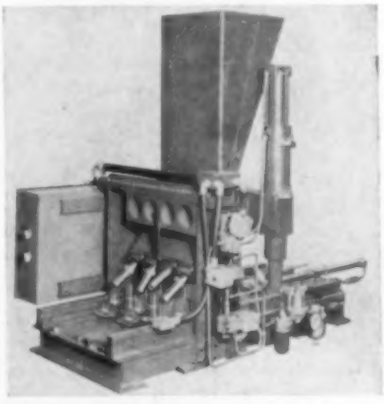
Ball & Jewell M-100 Granulator

The large bin, 12 by 10½ by 20 inches, has an oversize sight glass for determining fullness. M-100 is equipped with a 1½-hp motor and starter; 2- or 3-hp motors are optional. Casters are included as standard equipment.

Baker Automatic Loading Board

An automatic loading board designed expressly for use with Baker 15, 25, 50, 75, and 100-ton presses, has been introduced by Baker Brothers, Inc., Toledo, O. Intended to increase production of molded parts at lower unit cost, the actuating board of the loader is supplied blank for drilling to any mold combination.

Either of the present four or eight-cavity powder feeders can be mounted on the new loading board. A typical application (see photo) has the board drilled for feeding 12 cavities, three to a row. As each row is filled, the board indexes forward automatically to align the next row. On completion of the process, the actuating board transfers completely into the press where the parts are molded and ejected. The board is air-actuated, interlocked, and cycled with the press to load during curing.



Four-Cavity Feeder mounted on new Baker automatic loading board

Hydraulic Injection Molder

A small, automatic, hydraulic injection molding machine, designated GM 10 and manufactured by Hahn & Kolb, Stuttgart, Germany, is now available through Donald C. Seibert, importer of technical and industrial equipment, Wilmington, Del. Reported to be the first small injection molder for thermoplastic materials employing rapid cycling, efficient plasticization, and self-acting nozzle closure, GM 10 has the following specifications:

Shot volume, cu. in.	1.53
Shot weight, oz. (polyethylene)	1
Locking strokes/min. (idle)	25
Possible shots/min.	15
Plasticizing rate, lbs./hr.	17.5
Max. heating power, kw.	3.2
Pump power, hp.	5.5
Max. daylight opening, in.	14
Available molding area, sq. in.	7.75
Injection pressure, psi.	11,350
Mold locking and injection power, tons	11

The nozzle is provided with a self-acting closure to prevent leakage of highly liquid materials. The distance which the heating cylinder carrier is moved by the mold carrying plate can be adjusted to effect the desired shot capacity. Withdrawal of the closing piston is brought about by reversing the oil feed valve.

The unit is equipped with a control system allowing manual, semi-automatic, or fully automatic operation. Curing periods are timed by adjustable electronic time relays. Voltage for control and heating is 220 volts A.C., with the standard drive motor set for 220/380 volts three-phase A.C. 60 cycles. Other voltages require a transformer for the control and heating elements.

Standard equipment includes a 900-rpm. high pressure pump with V-belt drive, solenoid operated pilot valve, manometer for injection and control pressure, a regulating transformer for the main heating system, two ammeters, a distance thermometer, filling chamber with injection piston, corrosion-resistant heating cylinder, 2000-watt heating bands, and a 2.5-mm. diameter nozzle.

Hahn & Kolb Injection Machine

Auto-Vac 1955 Model Vacuum Former

Vacuum Forming Machine

Five sizes are available in the 1955 models of vacuum and drape forming machines manufactured by Auto-Vac Co., Inc., Fairfield, Conn. The new units, all of which incorporate the latest design and construction improvements, are marketed in the following standard machine sizes: 24 by 36 inches, 30 by 50 inches, 42 by 60 inches, 42 by 72 inches, and 48 by 72 inches.

Chief among the new concepts incorporated into the new models is the "3-D double-action drape," which is reportedly achieved with a new four-way adjustable clamping frame which can be set at any height up to 24 inches above the molding table, and the retention of fully adjustable draping distances up to 12 inches.

Combination male-female molds with maximum cavity depths and elevations of 12 inches may be placed on the mold table with the frame adjusted to maximum elevation of 24 inches above the table. After the piece is formed, the drape frame will lift the article clear of the mold.

No special holding dies are necessary due to the synchronized, automatic lever-and-toggle action of the clamping frame. The heating unit is constructed with G-E Calrod units which overcome perimeter heat loss by increasing the heat output at both ends. Super-sensitive thermocouples permit maintenance of any desired temperature within five degrees.

The instrument control panel is flush-mounted and contains both automatic and manual controls. Hinged, it permits easy access to machine parts, which are all consolidated in the area immediately in back of the control panel.

Other features include adjustable water-cooled frame; metered air blow-off; suitability for use with the controlled draping and "bubble pack" packaging processes; and numerous safety factors. An eight-page booklet, Bulletin No. 55, is available without charge from the company.

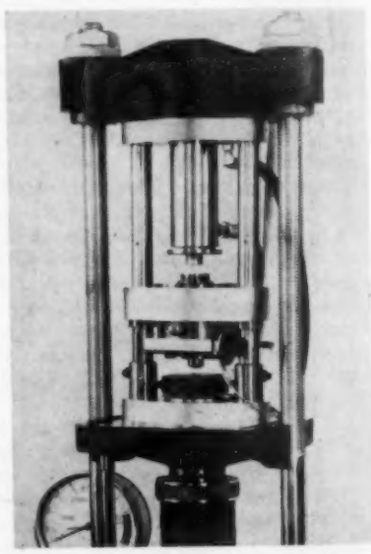
Self-Contained Press Converter

A device which can be placed between the platens of any vertical hydraulic press and reportedly convert it into an injection, transfer molding, or extrusion press has been developed by Plastic Machinery Exchange, Boonton, N. J. Designated Plastic Molding Conversion Device, and designed for small production runs, it is said to obviate the necessity of breaking-down a large machine which is set up for a much longer run. Other uses include laboratory-scale experimental and control work.

The floating center crosshead holds the heating chamber which is electrically controlled. The press closes the device by forcing the bottom crosshead up against a nozzle, which in turn raises the heating chamber up against a hydraulic cylinder and locks. Hydraulic pressure applied to the top of this cylinder forces the plunger into the heating cylinder, thus injecting the plastic material into the mold. Hydraulic or air pressure applied to the lower end of the cylinder withdraws the plunger, following standard injection molding machine procedure.

Enclosed springs in the hollow vertical guides cause the device to open on release of pressure. The crosshead drops to the stop collars, leaving sufficient clearance between the mold and the nozzle to permit removal of the molded material and allow for refilling.

The simplest form of the device has a shot-rated capacity of ¾-1 ounce, with pressure supplied by the plant's power lines or from a small hydraulic pump. The device can be supplied in larger sizes with multiple-cavity molds for use with larger presses. The unit is supplied with thermometer and thermoswitch for regulation and control, and provision is made for the attachment of a small hopper.



Compression press equipped with Converter for injection molding.

Universal Testing Instrument

A compact table model Instron Universal Testing Instrument, for electronically computing stress-strain curves under tension or compression, has been introduced by Instron Engineering Corp., Quincy, Mass. The unit comes in two separate assemblies for ease of handling; a testing assembly, and a control cabinet.

Intended for research as well as quality and production control requirements, the table model Instron reportedly offers simplicity of operation. With accessories, it is claimed to be sufficiently flexible to satisfy the most rigid research programs in the plastics, rubber, and other industries.

Full-scale loads from 2 grams to 200

Table Model Instron Universal Testing Instrument

pounds are possible through the choice of three load cells. Inertialess weighing permits rapid response to load fluctuations within the sample, and mechanical friction is eliminated. A choice of synchronous chart speeds provide extension magnification. Three inches of space are provided around the crosshead assembly to accommodate special conditioning chambers without modifying the unit.

Optional equipment includes load cycling, extension cycling, gage length and rapid return, compression load cell, variable crosshead speed drive, X-Y chart drive for extensometer, and automatic integrator. Specifications are listed as follows:

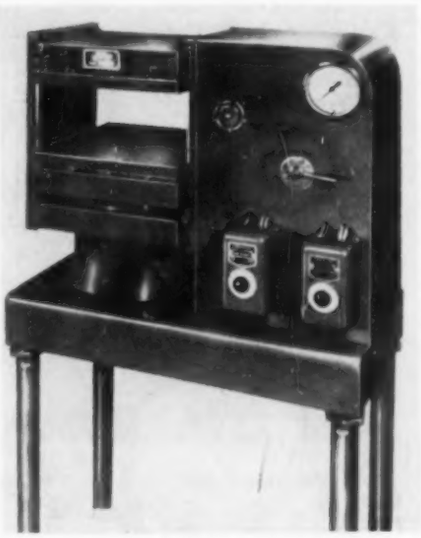
Crosshead speeds, std., in./min.	0.2-50
Low speeds, in./min.	0.02-5.0
Maximum crosshead travel, in.	33
Chart speeds, in.	0.2-50
Horizontal space between drive screws in.	15
Overall dimensions, testing assembly, in.	24 x 24½ x 42½
Control cabinet, in.	22 x 18 x 39
Weight, testing assembly, lbs.	75
Control cabinet, lbs.	150
Power requirements, volts	110
Cycles, A. C.	60
Watts	200

Compact Hydraulic Press

A compact hydraulic press for precision molding of rubber and plastics, and for other laboratory and production uses where controlled heat and pressure are required, has been introduced by Atlas Hydraulics, Inc., Philadelphia, Pa. Called Model 60-12, the press has simple individual controls that can regulate hydraulic pressure for each operation within a 50-4,000 psi. range, or a total possible hydraulic pressure of 60 tons.

Model 60-12 is manufactured with a choice of electrically-heated 12- or 14-square inch platens. A specially-designed cooling system reduces platen transfer heat on the ram, ram pot, hydraulic oil, and packing, the company reports. This reduction of heat prevents acceleration of chemical changes in the oil and maintains its viscosity and acidity, doing away with deposition of gums and varnishes on highly polished surfaces.

Power source of the unit is an air-hydraulic boost pump which is said to maintain accurate and consistent pressure on the platen area. For fast platen closure, air is entered into an oil reservoir to raise the ram; high pressure is achieved by the air driving a large surface piston which in turn motivates a small oil piston.



Model 60-12 Atlas Hydraulic Press

Dry Ice Crusher

A machine for crushing dry ice, the Supreme Dry Ice Crusher, has been placed on the market by Franklin P. Miller & Son, Inc., East Orange, N. J. Dry ice, mixed with newly-manufactured plastic and rubber parts in a tumbling barrel, is valuable in the polishing and removal of flash from such parts; imperfections harden and abrade off, and the dry ice evaporates, resulting in complete separation of the finished parts.

Capable of adjusting the size of the dry ice particles for different sizes and compositions of parts, the crusher accomodates a full 50-pound standard block of dry ice, and operates at a rate of 2-4 tons of ice per hour. Powdered dry ice can also be produced. The machine is powered by a 1½-hp. motor through a built-in direct gear reduction drive, occupies a floor space of 20 by 22 inches, and weighs 325 pounds.

Other uses for crushed dry ice in the plastic and rubber industries include embrittlement for pulverizing, as moisture traps in vacuum systems, and for environmental testing.

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New Products

Nylon Fabric Garage Supported by Collapsible Steel Tubing and Coated with Geon Vinyl.

Vinyl Coated Nylon Garage

A semi-permanent plastic garage, consisting of B. F. Goodrich's Geon vinyl coated over nylon fabric and attached to an all-steel tubular frame with multiple spring action, is being manufactured by Domestic Film Products, Millersburg, O. Called Car Castle, the garage is being distributed exclusively by Stines & DeMet Mfrs. Associates, Glenview, Ill.

Resistant to all climatic conditions, the nylon-vinyl combination has a tensile strength of 1,300 pounds per foot of width, and is pliable at —30° F. The vinyl coating reportedly resists the effects of salt, sand, sunlight, oils, greases, alkalies, and acids.

Operation resembles the action of overhead garage doors or a convertible auto top. Two center steel tubes are driven into the ground approximately 14 inches apart, with the rest of the frame folded against them. The automobile is driven between the posts, and the fabric and frame are pulled up and over, front and back. The entire unit measures one- by one- by six feet when folded, and weighs 87 pounds.

Durable Plastic Engraving Stock

Bolta-Grav, a new plastic engraving stock which reportedly incorporates ease of engraving, long life, and low cost, has been introduced by Bolta Products Division, General Tire & Rubber Co., Lawrence, Mass. The material is flexible, and can be low-pressure molded or line-bent to virtually any desired shape without chipping or burring.

Weighing approximately one-quarter less than phenolics and two-thirds less than aluminum, Bolta-Grav is said to be shatterproof and highly resistant to scratches, abrasion, water, solvents, and chemicals. It can be sheared, punched, printed, embossed, stamped, nailed, riveted, die cut, stapled, and stitched.

Available in a variety of colors and finishes, Bolta-Grav is sold by the square foot. Physical properties are as follows:

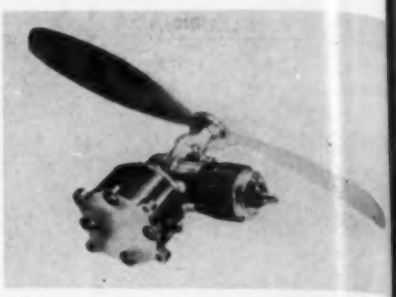
Specific gravity	1.05-1.24
Density, lbs./cu. ft	68.37
Specific volume	0.913
Tensile strength at 72° F., psi.	4.4
Modulus of elasticity in tension, psi. x 10^5	2.5
Izod Impart at 70° F., ft.-lbs./in. notch	10.2
Compressive strength, psi.	6,000
Flexural strength, psi.	5,000
Modulus of elasticity in flexure, psi. x 10^5	2.38
Impact strength, falling ball, at 72° F.	5.0
Hardness: Shore "D"	83
Rockwell "R"	90
Flame resistance: Burning rate, in./min.	2.5
CAA	3.5
Specific heat, calorific method	0.35
Thermal distortion at 264 psi., °F.	160
Thermal conductivity, Cenco Fitch, Btu./hr./ft.²/°F./in.	1.0
Shrinkage, max. at 270° F., %	7.0
Water absorption in 24 hrs., %	0.563
Taber abrasion, wt. loss in gms. after 5,000 revs., CC 17f wheel	0.144

Nylon Fuel Tank

A fuel tank of light weight nylon, which makes possible increased fuel capacity and longer running time, has been molded by Auburn Button Works, Inc., Auburn, N. Y. Intended for use with the "O. K." Cub miniature aircraft engine, the entire tank unit including the propeller weighs less than 1½ ounces, approximately half the weight of cast aluminum tanks.

Despite its light weight, the engine turns at 12,000 rpm., requiring materials to withstand considerable vibration and torque. Red in color, the tank is translucent so that the fuel level can be determined readily. Being inert, nylon resists the chemical action of miniature fuels.

A V-shaped bead serves as a leakproof gasket connection. Vinyl tubing, extruded by Auburn, connects the mixing chamber at the front of engine with the fuel tank and provides a leakproof permanent connection. Four machine screws pass through integrally molded holes to mount the tank on the engine. Holes molded into four lugs at the base of the tank mount the power unit on the plane.



Model Airplane Engine Unit Features Fu Tank of Molded Nylon.

Pressure-Sensitive Vinyl Tape

A new vinyl tape for general purpo applications requiring complete electric and mechanical protection, has been intro duced by Bishop Mfg. Corp., Cedar Grov N. J. Available in two thicknesses of seve and ten mils, the tapes are designate Bishop Vinyl Electric Tape Nos. 1 and respectively.

The tape is said to feature an improve method of bonding the adhesive to th vinyl which prevents transfer, thereb eliminating objectionable tackiness on th backing with resultant loss of adhesiv strength. Thin, tough, and resilient, th tape furnishes a tightly wrapped splice fo fixture openings, junction boxes, conduit and power transmission and distribution cables.

The tape shows excellent resistance t chemicals and corrosion, according t Bishop. Physical and electrical properties as determined by ASTM test methods ar listed as follows:

	Tape No. 1	Tape No.
Tensile strength, lbs./in. width	25	30
Elongation, %	150	150
Adhesion to steel, ozs./in. width	35	35
Adhesion to backing, ozs./in. width	32	32
Dielectric constant, 60 cycles	3.2	3.2
At 10^6 cycles	2.3	2.3
Power factor, 60 cycles	0.07	0.07
At 10^6 cycles	0.03	0.03
Insulation resistance, megohms	200,000	200,000
Electrolytic corrosion factor	1	1
Dielectric strength, volts	10,000	13,000

Bishop Pressure Sensitive Vinyl Tape

Top and Bottom Views of Window "Friction Shoes" Molded Phenolic Resin.

Phenolic Anti-Friction Shoes

Small anti-friction shoes, molded from Durez's impact-resistant phenolic resin by the August C. Frank Co., Philadelphia, Pa., replace the laminated parts formerly used by the Michael Flynn Mfg. Co., in their Lupton "Master" Aluminum Windows.

Self-lubricating, the shoes do not crack during assembly, and offer noticeable savings in material costs. The base of the shoe is thick and built up to the height of the rivet, enabling them to slide in channels at the jams.

Vinyl-Sprayed Parade Float

First prize at the 1955 Tournament of Roses in Pasadena, Calif., went to "Holy Mackerel," a float sponsored by the San Pedro Junior Chamber of Commerce. The float featured a huge fish, and was made by Miller Bros. & Hastein, Inc., of Pasadena, by spraying Bakelite vinyl resin over preshaped wire mesh.

Only one-tenth the weight of conventional plaster of paris-soaked cheese-cloth, the skin covered a framework of chicken-wire stapled to lightweight steel rods. Vinyl web-coating, supplied by Eronel Industries, Hawthorne, Calif., was sprayed over the mesh until the skin was built up to the desired thickness. Labor and materials costs were reportedly cut by as much as 20%.

Vinyl-Sprayed Float Wins Prize at 1955 Tournament of Roses

One-Piece Polyethylene Vial

A series of polyethylene vials featuring integrally molded hinged caps has been introduced by Olympic Plastics Co., Inc., Los Angeles, Calif. Called Polyvials, they are reportedly gaining wide acceptance by the drug trade and other industrial users throughout the country.

Vial contents are plainly visible; printed labels may be inserted, or attached to the outside with adhesive. The vials have been used to package tablets, capsules, prescription powders, precision instruments, bearings, electronic parts, glue, and workshop supplies.

Unbreakable and waterproof, the lightweight vials are available in natural and green colors. Four sizes are being marketed, 2-, 4-, and 7-, and 10-dram vials, with 12- and 14-dram sizes scheduled for addition by summer. Other shapes and sizes are available as custom moldings.

Olympic One-Piece Polyethylene Vial

Advertising Matter Printed on Vinyl Display Banners

Printed Krene Display Banners

Advertising messages are being printed on Krene vinyl display banners by the Charles W. Brown Advertising Co., Inc., Schenectady, N. Y., utilizing the silk-screen process. Light-weight and moisture-resistant, the banners may be displayed both indoors and out.

Fast-drying inks are said to print readily with Krene, a product of Bakelite Co., New York, N. Y., and effect a lasting ink bond. Display pieces can be rolled and folded without cracking or forming permanent creases which would injure the printed area.

Fluorocarbon-Fiberglass Film

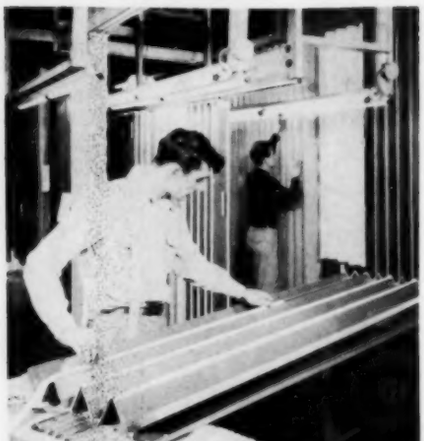
A new sheet material comprising glass microfibers and Du Pont's Teflon, and reportedly possessing high dielectric properties, has been introduced by the American Machine & Foundry Co., New York, N. Y. Designated "Fiberfilm," the very thin sheets are available in continuous lengths or rolls up to 40 inches wide, and in both porous and non-porous forms.

Both forms perform satisfactorily at temperatures from 200-250° C.; their dielectric breakdown strength ranging from 1,400-4,000 volts per mil D.C. The non-porous variety is marketed in thicknesses of 0.8-1.7 mils, and as laminations. It finds applications as a dielectric for high temperature low-loss capacitors, and for interlayer insulation in coils, wires, and cables.

Porous "Fiberfilm" is available in thicknesses from 0.6-13 mils and in a variety of fluorocarbon-to-glass ratios. Maximum pore size is closely controlled at any desired porosity level from 5-100 microns, according to company spokesmen. End-uses include interlayer insulation for high temperature coils and transformers where the entire assembly is impregnated with silicone resins; spacers in tantalum electrolytic capacitors; and filter mediums for severely corrosive high temperature conditions.

Typical properties of 1.3-mil non-porous "Fiberfilm," as determined by ASTM test methods, are listed as follows:

Tensile strength, psi., at 25° C.	2,200
At 125° C.	1,210
Elongation at break, %, at 25° C.	30
At 125° C.	24
Stiffness, cms., at 25° C.	5.5
At —70° C.	6.6
Tear resistance, gms., at 25° C.	23
Specific gravity	2.1-2.2
Flammability	Non-flammable
Dielectric strength, volts/mil, ¼-in. electrodes	2,300
Two-inch electrodes	1,200
Dielectric constant, 60 and 1,000 cps., at 25° C.	2.1
At 125° C.	2.0
Dissipation factor	0.001
Volume resistivity, 45% R.H. at 25° C., ohm-cms.	10^{15}
Surface resistivity, 96% R.H. at 25° C., ohms	10^{12}



Extruded Geon Vinyl Strips Being Installed As Hinges For Panelfold Doors

Vinyl Hinged Panelfold Doors

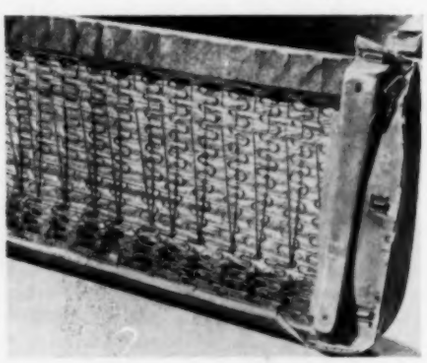
Wood panels hinged together with either matching or harmonizing flexible strips of B. F. Goodrich's Geon vinyl make up a new type accordion folding door introduced by Panelfold Doors, Inc., Hialeah, Fla. Designated Panelfold, the doors extend and stack on nylon wheels traveling on a heavy extruded aluminum track.

The 3½-inch wide solid wood panels are available in 64 standard finish combinations, or in custom panels of natural wood with a clear lacquer finish. Stock doors are 78 and 80½ inches high, with widths to 50 inches. Larger sizes can be had on custom or special order.

Purchased singly or in pairs, the doors act as dividers for large rooms and provide a practical answer to the demand for freedom and flexibility in modern doorway design. The vinyl hinges are reportedly very durable, and will flex and fold for many years without cracking or otherwise deteriorating.

Laminated Polyethylene Pad

A pad designed to prevent the sagging or cupping of automobile seat cushions has been introduced by Gordon-Chapman Co., Detroit, Mich. The essential ingredient of the pad is Visqueen, a polyethylene film manufactured by Visking Corp., Terre Haute, Ind.



Bottom Section of Auto Seat Showing Visqueen Polyethylene Pad

Two sheets of the film are laminated and reinforced through the center with saran monofilament extrusions at regularly spaced intervals. The entire lamination is bonded by a permanent plastic adhesive. Designated Elast-O-Pad, the product extends the entire length of the padding member, being placed between it and the seat springs.

Junior Leaguer Protective Cap

A plastic protective baseball cap of molded Tenite butyrate, has been introduced by American Baseball Cap, Inc., Pittsburgh, Pa. High in impact strength, the cap offers protection against thrown or batted balls.

The chipproof cap is available in red, navy blue, or royal blue colors, and in a range of junior sizes. Molded by Industrial Plastics, Inc., the cap has a rubber headband and cushion for comfortable fit.

Molded Tenite Junior Baseball Cap

Plastic Lined Outdoor Pool

A low-cost excavated swimming pool is possible using Bakelite's Krene vinyl plastic sheeting as a water resistant lining for porous concrete block pool walls. The lightweight, durable liners are designed and produced by Bilnor Corp., Brooklyn, N. Y., in three standard pool sizes.

Panels of clear Krene are sealed into the ends of the liner to accommodate underwater lighting for night swimming. Water-resistant, the lining prevents seepage through the porous concrete, thereby eliminating the need for an expensive pool floor and costly annual reconditioning. Graduated in depth from three to five, seven, or nine feet, the flexible liner is designed to rest on a poured concrete footing and be supported at the sides by sections of ½-inch galvanized pipe which extend over the concrete-block sidewalls.

Three sizes are available through Lin-O-Plast Corp., Brooklyn, N. Y.: 12 by 27 feet; 16 by 32 feet; and 20 by 40 feet. The liners are resistant to abrasion, oils, grease, pool algae, and water purifying chemicals. Standard plumbing drains may be attached to the bottom, and the liner itself can be washed with soap and water. Pool covers are listed as optional equipment.

Exide 3-COE-7 Tytex Battery Unit with Transparent Styrene Case

Exide Plastic-Cased Battery

The first plastic-cased battery to be approved by Underwriters Laboratories, Inc., for use in emergency lighting-unit equipment is the Type 3-COE-7 battery, manufactured by Exide Industrial Division, Electric Storage Battery Co., Philadelphia, Pa., and used in Exide Lifeguard Models ME and TE.

Eight to twelve years of service life is anticipated for the battery due to its quarter-inch-thick pasted type positive plates and active material, which is locked into both positive and negative plates by a series of strong horizontal and vertical grids. This reportedly assures permanent contact and low internal resistance.

Additional features include double insulation of microporous rubber and Vitrex retainers, both impervious to the action of the electrolyte. Exide gray polystyrene, molded to close tolerances, furnishes a tough transparent cover. Colored pilot balls, discernable from distances up to 30 feet, float in a vertical channel molded into one corner and indicate the state of charge.

The battery has a range of capacities from 10-30 ampere-hours, and requires the addition of water only once or twice a year. Similar COE batteries find applications in switchgear and relay actuation, radio and TV circuits, signal control for alarm systems, and railway signals.

Krene Vinyl Plastic Pool Liner Installed and Ready for Filling

Book Reviews

"Paint and Varnish Manual—Formulation and Testing." P. L. Gordon and R. Gordon. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth, 5 by 7¼ inches, 182 pages. Price, $3.50.

The fifth in a series of six science manuals, this book describes the laboratory procedure, terminology, and techniques peculiar to the paint and varnish industry. The two broad classifications in laboratory practice are preparation and evaluation of the intermediate vehicles which comprise the base for surface coatings, and application of the paints themselves.

Similarly the manual is divided into two sections. The first introduces oils, resins, and varnishes; describes experiments for the preperation of 33 such materials; and gives test procedures for determining their physical properties. Section two deals with pigmented coatings in similar fashion. A 12-page appendix lists bulking values, equipment and materials required, and a temperature conversion table.

"Chemical Business Handbook." Edited by John H. Perry. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York, N. Y. Cloth, 7½ by 10½ inches, 1,330 pages. Price $17.00.

This volume takes the whole complex world of chemical industry as its scope, and neatly divides and subdivides its manifold phases into intensively documented segments that constitute the right sources for the right reader at the right time. The work of 124 contributors, the book is arranged in 20 major sections that provide a sort of microcosm of the life and times of a chemical company, from the financing needed to give it birth, through industrial purchasing, production, sales, and advertising, to the business mathematics that judge its prosperity or failure.

"Chemical Business Handbook." Edited by John H. Perry. McGraw-Hill Book Co., Inc., New York, N. Y. Cloth, 7½ by 10½ inches, 1330 pages. Price, $17.00.

This volume takes the whole complex world of chemical industry as its scope, and neatly divides and subdivides its manifold phases into intensively documented segments that constitute the right source for the right reader at the right time. The work of 124 contributors, the book is arranged in 20 major sections which provide a sort of microcosm of the life and times of a chemical company, from the financing needed to give it birth, through industrial purchasing, production, sales, and advertising, to the business mathematics that judge its prosperity or failure.

"Emulsion Polymerization." Frank A. Bovey, I. M. Kolthoff, Avrom I. Medalia, and Edward J. Meehan. Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. Cloth 6¼ by 9¼ inches, 457 pages. Price, $12.50

Polymerization mechanisms in general are explained as a background to the understanding of emulsion polymerization. Chain transfer agents are discussed, and inhibition, retardation, and copolymerization are presented both from the general and the emulsion polymerization viewpoints.

The properties of detergents are of primary importance in the study of emulsion polymerization of styrene, especially with respect to kinetics. The book emphasizes theoretical fundamentals and quantitative interpretation of emulsion polymerization phenomena, obtained chiefly from a study of the development of GR-S. Standard (Mutual) and modern redox recipes are included, along with a qualitative interpretation of activated recipes for the preparation of "cold rubber."

Author and subject indexes are included at the back of the book.

"Glass Reinforced Plastics." Edited by Phillip Morgan. Philosophical Library, Inc., 15 E. 40th St., New York 16, N. Y. Cloth, 6¼ by 10 inches, 248 pages. Price $10.00.

Compiled by the editor of "British Plastics," this work consists of contributions by 15 British authorities in the field. The subjects of these chapters are: glass fiber forms and properties; the chemistry of unsaturated polyester and allyl resins; polyester types and properties; ancillary materials; glass fibers with phenolic resins; silicone, melamine; epoxide, and furane resins; commercial molding processes; methods of mass production; tube and rod production; design and properties of structures; glass reinforced plastics in the aircraft industry; glass fiber laminates in the elecrical field; automobile bodywork and other transport applications; boat building in glass reinforced plastics; and miscellaneous applications of glass reinforced plastics.

As with many British texts, a natural rather than didactic "specialist" style is employed. Many tables, formulas, and illustrations are included, and a list of references is found at the end of each chapter.

Written in clear concise English, the book should be of interest to a wide range of personnel in the reinforced plastics field. Sales and production men as well as research chemists and technologists will find the work most helpful in evaluating comparative techniques.

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New Literature

"Motion Picture Film Catalogue of the Plastics Industry." The Society of the Plastics Industry, Inc. New York, N. Y. 12 pages.

This catalog lists, describes briefly, and gives the showing time and availability of industrial motion pictures on various phases of the plastics industry.

"Witcarbs in Polyvinyl Chloride Resins." Technical Service Bulletin W-2. Witco Chemical Co., New York, N. Y. 2 pages.

This bulletin gives the general and physical properties of Witcarb V & P fillers for PVC resins.

"Epoxy Resin Adhesives." Armstrong Products Co., Warsaw, Inc. 18 pages. The general, physical, and electrical properties, test data, and prices for the company's epoxy resins, adhesives, activators, and mold release are given in this brochure.

"Opalon 410." Monsanto Chemical Co., Springfield, Mass. 21 pages.

This booklet gives information on the physical properties, steps in compounding, and applications of Opalon 410, the company's vinyl plastisol. Viscosity data with primary and secondary plasticizers, fillers, pigments, stabilizers, surfactants, and diluents are also given.

"Butyrate Peelable Plastic Packaging." Eastman Chemical Products, Inc. Kingsport, Tenn. 9 pages.

This booklet outlines the steps by which tools and other precision parts may be protected against corrosion, contamination, impact, and abrasion by hot dip coating with a 0.05-1.0 inch film of Eastman's cellulose acetate butyrate.

"#8212 Flash Primer for Phenolic Plastics." Finishes division, Interchemical Corp., Newark, N. J. 1 page.

Properties, uses, and method of application of this phenolic-base material are given in this bulletin, along with the bake schedule.

"New Developments in 'Mylar' Polyester Film." Product Information Service Booklet No. 2. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. 21 pages.

This illustrated booklet describes applications and types of "Mylar" polyester film, including specifications and physical properties. The new Circleville, O., plant is also shown in various phases of operation.

"Drilling Molded Polystyrene Parts." Technical Service Bulletin. Koppers Co., Inc., Pittsburgh, Pa. 2 pages.

This bulletin describes the drilling process, the speed and shape of the drill, and the cooling method and lubricants used to prevent fluxing and crazing of polystyrene.

"Automatic Proportioning Systems." Bulletin 0351. Richardson Scale Co., Clifton, N. J. 28 pages. This illustrated booklet describes the operation of the firm's Select-O-Weigh proportioning system that permits remote dialing of individual ingredient weights, and details 11 installation now in use in such industrial applications as liquid latex blending, automatic rubber compounding, maintaining tension on nylon fabric being processed, glass batching, and net weighing with automatic tare compensation.

"The SAE Story." The Society of Automotive Engineers, Inc., New York, N. Y. 56 pages. This is the history of the SAE—its founding, growth, and current organization and functions—which is now celebrating its 50th anniversary and boasts a membership in excess of 17,000.

"Directory of Commercial and College Testing Laboratories." American Society for Testing Materials, Philadelphia, Pa. 48 pages. Price, $1.00. Successor to a similar directory published by the National Bureau of Standards in 1947, this booklet contains alphabetical and by-state listings of 278 commercial testing laboratories, and 86 college laboratories prepared to do testing under certain conditions. Included are names, addresses, commodities that can be tested, and the nature of such tests.

"Syntactic Foam." Laminating Technical Release No. 4. Bakelite Co., New York, N. Y. 12 pages.

Properties, ingredients, and applications of the company's expanded phenolic, epoxy, and polyester resin foams are given in this bulletin. Sandwich core structures are described in detail; tables and illustrations are included.

"Chromalox Electric Heat for Better Plastics Processing." Edwin L. Wiegand Co., Pittsburgh, Pa. 36 pages.

Some 25 illustrated examples of typical applications of Chromalox electric heaters in plastics processing are contained in this booklet. The units themselves are described together with a listing of their advantages and applicable processes.

Publications of Godfrey L. Cabot, Inc., Boston, Mass.:

"General Properties, Functions, and Uses of Cab-o-sil." No. CGen-1. 7 pages. This booklet lists the chemical and physical properties and applications of the company's sub-microscopic silica filler.

"Aqueous Dispersions of Cab-o-sil." No. CMis-2. 4 pages. Chemical, physical, and dispersion properties are given, also two methods for the manufacture of Cab-o-sil sols.

"Cab-o-sil in Polyester-Glass Reinforcing Plastics." No. CPla-1. 4 pages. A description of the uses of Cab-o-sil with polyesters is given, together with two charts showing shear-viscosity relationships and effects on viscosity.

"Cab-o-sil in the Plastics Industry." No. CPla-2. 7 pages.

This bulletin describes the uses of Cab-o-sil as a thixotropic agent for polyester and epoxy resins, plastisols, and organosols; as a thickening and gelling agent for plastigels; as an anti-blocking agent for cellophane; and its experimental use with PVC, polyethylene, and polystyrene.

"A Manual for Reinforced Plastic Tooling." Marblette Corp., Long Island City, N. Y. 20 pages. Practical and profusely-illustrated, this handbook describes the fabrication and use of such plastic tools as spotting racks, welding and assembly fixtures, die molds, and matrices. Resins used include phenolics, polyesters, and epoxies, all glass-reinforced. Property charts are included.

"Campco GM." Cat. No. 414. Campco Division, Chicago Molded Products Corp., Chicago, Ill. 4 pages. This illustrated catalogue describes the high-gloss GM finish available on the company's impact styrene sheet, and gives numerous product applications.

"High Impact Styrene Sheets." Auburn Button Works, Inc., Auburn, N. Y. 4 pages. Properties, chemical resistance, and approximate sheet weights are tabulated, along with a description of their texture, formability, and the two available finishes.

"Synvar Laminating Resins." Synvar Corp., Wilmington, Del. 10 pages. This folder contains six specification bulletins; the first gives general information on applications, and the other five list the physical properties for Synvaren Laminating Varnishes, Nos. 920, 935, 640, 9203, and CAS-55.

"R/M Products for Reinforced Plastic Laminates." Bulletin No. T-55. Raybestos-Manhattan, Inc., Manheim, Pa. 44 pages. This bulletin describes and lists the composition, mineralogical and physical properties, and effects of temperature on weight for five types of asbestos. Property charts and graphs for R/M Pyrotex felt laminates, Novasbestos paper laminates, and asbestos-cloth laminates are also included.

Abstracts of Important Articles

MATERIALS

"Time, Temperature, and Rupture Stresses in Reinforced Plastics," S. Goldfein, *Modern Plastics*, 32, 4, 148 (Dec. 1954).

Time-temperature relationship studies for determining rupture stresses in metals at elevated temperatures can be applied to glass-reinforced polyester resin laminates. Use of this equation permits use of short-time tests at elevated temperatures to determine long time data at room temperature, and presentation of complete rupture characteristics of the laminate on a single curve.

"Reactions of Allylic Silicon Compounds," D. L. Bailey and A. N. Pines, *Ind. Eng. Chem.*, 46, 2, 2363 (Nov. 1954).

Allylic chlorosilanes react readily to form copolymers with organic vinyl compounds such as styrene. The resulting resins have excellent insulating properties and solvent resistance, but possess poor thermal stability.

"Silicone Molding Resins," H. N. Homeyer, J. H. Preston, and S. Casapulla, *Ind. Eng. Chem.*, 46, 2, 2349 (Nov. 1954).

Recently developed silicone molding compounds have the same physical strength and molding ease of phenolics; moreover, they show outstanding electrical resistance, even after prolonged exposure to extremes of temperature and humidity.

"Mechanical Properties of High Polymers. I. Polyvinyl Acetate," Philip C. Scherer and Suresh N. Chinai, *Modern Textiles*, 36, 1, 74 and 36, 2, 48 (Jan.-Feb. 1955).

Contrary to previously published reports, new experiments indicate that the shape of the molecular weight differential distribution curve does not affect the properties of polyvinyl acetate film. Results of tests on Vinylite AYAF are summarized, and curves plotted of weight distribution versus fold, tensile strength, and elongation; and mechanical properties versus shape factor.

"Blends of Styrene-Acrylonitrile Resins with Rubbers," Willard de Camp Crater, *SPE J.*, 11, 2, 15 (Feb. 1955).

Styrene deficiencies, such as brittleness and low softening temperature, can be overcome by copolymerization with other monomers such as butadiene-acrylonitrile. A complex system, individual resins and rubbers must be tailor-made to obtain the most desirable characteristics. The opaque blends have a full range of color application.

"Fundamental Low Temperature Retraction Studies of Natural and Synthetic Elastomers," Lee J. Radi and Normán G. Britt, *Ind. Eng. Chem.*, 46, 2, 2439 (Nov. 1954).

A graphic deviation from the true sigmoidal norm curve, characteristic of standard stress-strain tests of elastomeric materials at low temperatures, result when elastomers are permitted to retract at a constant temperature rather than at a temperature increase of 1° C. per minute. The magnitude of such deviation is a measure of the degree and rate of crystallization.

"Blends of Styrene-Butadiene Resins with Rubbers-Rigid Compounds," C. R. Holt, *SPE J.*, 11, 2, 13 (Feb. 1955).

Styrene-butadiene resins, not especially useful as end-products, can be compounded with rubber to produce modified blends. Cured, they possess excellent impact-strength, tensile strength, low specific gravity, and good electrical properties. Other additives may be used to alter properties. Applications include athletic and crash helmets, desk pads, automotive door-pads, and shipping containers.

"A Sporting Approach to Strong Plastics," James W. Case, *SPE J.*, 11, 1, 24 (Jan. 1955).

Strength, flexibility, and mechanical durability of laminates are dependent on the strength and positioning of the reinforcing fibers, the straightness of the load-deformation curve to the elastic limit, and the degree of bond between the fiber and the resin. Glass Fibers used as reinforcing materials are discussed and evaluated.

"Resin-Rubber Rigid Blends, A Summary," Anthony J. Urbanic, *SPE J.*, 11, 2, 20 (Feb. 1955).

The primary advantages of adding rubber to resins are improved toughness and impact strength. Important minor advantages are hot tear strength and lower processing temperature. Disadvantages include lower heat distortion, hardness, and tensile strength. Other resin rubber blends which have been shown to be useful are Epon-Thiokol systems, and blends of neoprene-new styrene and GR-S-ethyl cellulose.

"Blends of Polyvinyl Chloride with Rubber," W. J. Smith, *SPE J.*, 11, 2, 18 (Feb. 1955).

Acrylonitrile-butadiene copolymers are commonly used for plasticizing PVC. Applications include jacket insulation on coaxial cable, primary insulation, upholstery sheeting, extruded shoe welting, tubing, packaging film, and cured compounds for gaskets and valve disks.

"Cellular Polyethylene," W. T. Higgins, *SPE J.*, 11, 1, 36 (Jan. 1955).

For certain electrical applications, polyethylene is combined with an inert gas to produce a cellular structure. Desired property changes include: lighter weight, lower dielectric constant and thermal conductivity, and greater buoyancy, with little or no sacrifice in chemical inertness, moisture resistance, low temperature behavior, and power factor. A properly selected blowing agent releases the gas upon application of heat, and sufficient pressure is exerted by the extruder to prevent its expansion and escape.

"Blends of Phenolic Resins with Rubber," R. C. Bascom, *SPE J.*, 11, 2, 16 (Feb. 1955).

Phenolic resins are compatible with nitrile rubbers which increase the resin's elongation and impact strength, while lowering its hardness and tensile strength. Powdered rubber is added to the powdered resin and fillers, fluxed, and granulated to form a tough uncured compound. The cured blends have a multitude of applications.

"Blends of Styrene-Butadiene Resins with Rubbers-Non-Rigid Compounds," Harold S. Sell, *SPE J.*, 11, 2, 14 (Feb. 1955).

Increasing the elastomer content increases impact resistance, but gradually lowers hardness, tensile strength, and modulus to form a leather-like non-rigid compound. Incorporation of resins into the rubber batch is readily accomplished on conventional rubber equipment. Applications are found in the synthetic shoe sole, wire and cable, and flooring industries.

"Polymerizable Derivatives of Long-Chain Fatty Acids," William S. Port, Edmund F. Jordan, Jr., William E. Palm, Lee P. Witnauer, John E. Hansen, and Daniel Swern, *Ind. Eng. Chem.*, 47, 3, 472 (Mar. 1955).

Tests were conducted to show the relationship between external and internal plasticization by the preparation of a vinyl chloride copolymer which would resemble plasticized-PVC in properties. Vinyl stearate and other vinyl esters such as acetates, caproates, pelargonate, laurate, myristate, and palmitate were used in varying percentage compositions. The authors conclude that a long side chain is more effective than a short one in producing plasticization, and that similar molecular mechanisms operate in both systems.

"Polymerization by Gamma Ray," Leigh C. Anderson and Joseph J. Martin, *Modern Plastics*, 32, 7, 94 (March, 1955).

Gamma ray polymerization of alkenes may produce both desirable and undesirable features in the finished product. High polymers with adjacent long chains are moldable, whereas cross-bridging leads to a larger, more rigid molecular structure, as illustrated by vulcanized rubber. Extensive studies must be undertaken before the effects on any one polymer may be known and the best conditions for irradiation ascertained.

"Determination of Heat-Sealability of Coated Cellophane Films," K. S. Kunze, *Kunststoffe*, 45, 1, 16 (Jan. 1955).

A method is described which is said to have been used successfully for several years, and to give reproducible results. The method is published in the hope of stimulating discussion which will lead eventually to the fixing of a standard. (In German).

EQUIPMENT

"Calculating Extruder Performance," Ernest C. Bernhardt, *Modern Plastics*, 32, 6, 125 (Feb. 1955).

Extruder capacity and performance can be predicted by means of a simplified equation involving the two main flow components: drag flow, which is forward conveying action; and pressure flow, which is produced by back pressure at the die.

"Thickness Control by Beta Gages," Gilbert Corwin, *Modern Plastics*, 32, 7, 104 (March, 1955).

An absorption gage and a backscatter gage, both using beta particles to measure sheet thickness during production, are described.

"The Caplastometer: A New Melt Viscometer," H. J. Karam, K. J. Cleereman, and J. L. Williams, *Modern Plastics*, 32, 7, 129 (March, 1955).

Disadvantages of existing rheometers are listed and a schematic capillary rheometer is described which can be operated at temperatures and shear rates comparable to those found during extrusion and injection molding. Methods of plotting and interpreting data are presented, along with the instrument's use in evaluating and studying flow behavior of linear polymers.

PROCESSING

"Injection Molding Technique for Polyamides," F. Schaupp, *Kunststoffe*, 45, 1, 33 (Jan. 1955).

The processing conditions imposed by the major differences between polyamides and the usual injection molding compounds (i.e. higher melting point, lower viscosity, narrow melting temperature range, greater effect of moisture and processing on quality, and relatively high shrinkage) are discussed in detail, and a special injection nozzle for use with polyamides is described. (In German).

APPLICATIONS

"Plastics in Illuminating Technique," W. Sinn and A. Metzeler, *Kunststoffe*, 45, 1, 13 (Jan. 1955).

Plastics are being used increasingly in modern "daylight" illuminating techniques for home and commercial interiors. Important points to be considered in these applications, and a table of the properties of seven different plastics are presented. (In German).

"Applications of Irradiated Polyethylene. Part II, Formable Sheet," F. J. Bockhoff and J. A. Neumann, *Modern Plastics*, 32, 7, 103 (March, 1955).

Thick sheet material, capable of being deep-drawn, can be produced by irradiating polyethylene sheet. Physical and electrical properties, applications, and welding procedures for Agilene irradiated sheet are given. Deep draws are possible because of its flexibility over a wide range of temperatures.

"Some Results Obtained with Molded Plastics Bearings on Large Mining Trucks," E. Jacob, *Plaste u. Kautschuk*, 1, 11, 249 (Nov. 1954).

Details are given of experiments with laminated fabric bearings for rail trucks used for removing debris in lignite mines. (In German).

"Plastic Sandwich Beams," Melvin Mark, *Modern Plastics*, 32, 7, 146 (March, 1955).

The common radome material for airborne radar systems is a plastic sandwich-type structure with a low density core of honeycombed fibrous glass. Mathematical formulas are presented for calculating the moments of inertia and the flexural moduli of elasticity. Load-deflection ratios are tabulated.

"Applications of Irradiated Polyethylene. Part I, Two Types of Films," P. A. Goodwin, *Modern Plastics*, 32, 7, 102 (March, 1955).

Irrathene, the first commerial irradiated plastic, is being produced in large pilot-plant quantities for experimental purposes. Its use is still limited to tapes and films, and physical and electrical properties of two Irrathene films are tabulated and discussed.

Request for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. The publishers and their addresses are given below:

"ASTM Bulletin"
American Society for Testing Materials
1916 Race St., Philadelphia 3, Pa.

"Australian Plastics"
Australian Trade Publications, Ltd.
171 Sussex St., Sydney, Australia

"British Plastics"
Iliffe & Sons, Ltd.
Dorset House, Stamford St.
London S.E.1, England

"Canadian Plastics"
341 Church St., Toronto, Ont., Canada

"Chemical and Engineering News"
1155 Sixteenth St. N.W.
Washington 6, D. C.

"Hule Mexicano y Plasticos"
Filomeno Mata 13-11, Mexico, D.F.

"Industrial and Engineering Chemistry"
1155 Sixteenth St. N.W.
Washington 6, D. C.

"Industries des Plastiques Modernes"
Les Publications Techniques Associees
40 Rue du Colisee, Paris 8e, France

"Kunststoffe"
Carl Hanser Verlag
Leonard Eck Str. 7, Munich 27, Germany

"Kunststoff-Rundschau"
Brunke Garrels, Verlagsbuchhandlung
Borgfelder Strasse 83, Hamburg 26, Germany

"Materie Plastiche"
Via Farneti 8, Milan, Italy

"Matiéres Plastiques"
Rue Royal 326
Brussels, Belgium

"Mechanical Engineering"
American Society of Mechanical Engineers
29 W. 39th St., New York 18, N. Y.

"Modern Plastics"
575 Madison Ave., New York 22, N. Y.

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Bredgade 45, Copenhagen, Denmark

"Plastica"
Kunststoffeninstituut T.N.O.
Julianalaan 134, Delft, The Netherlands

"Plastics"
Temple Press, Ltd.
Bowling Green Lane, London E.C.1, England

"Plastics World"
Cleworth Publishing Co., Inc.
22 W. Putnam Ave., Greenwich, Conn.

"Plastiques Informations"
94 Rue Saint-Lazare
Paris 9e, France

"Plastverarbeiter"
Kurt Brandenburger
Klosterstr. 182, Edenkoben/Pfalz, Germany

"Poliplasti"
E.T.A.S., Via Andrea Mantegna 6, Milan, Italy

"Revista de Plasticos"
Inst. "Alonso Barba"
Serrano 119, Madrid, Spain

"Revue Générale des Matiéres Plastiques"
196 Ave. Jean-Jaures, Paris 19e, France

"Rubber and Plastics Age"
Rubber and Technical Press, Ltd.
Tenterden, Kent, England

"SPE Journal"
Security Bank Bldg., Athens, Ohio

Patent Digest

MATERIALS

Drying Polyacrylates. No. 2,701,391. John F. Yost, Noroton Heights, and Ilse B. Frederick, Glenbrook, Conn. (to American Cyanamid Co., New York, N. Y.)

The process comprises mixing an aqueous dispersion of a high molecular weight reaction product, an acrylic polymer, an ester of polyoxyalkylene, a fatty acid, and an inert non-tacky solid of high sorptive power. The dispersion is deposited on a moving surface, heated to evaporate the solution, and the resulting dried film is scraped off with a blade.

Salicylic Acid Cured Coating Composition Comprising an Epoxy Polyhydroxy Polyether Resin and an Amine-Aldehyde Resin. No. 2,703,765. Le Verne Kenneth Osdal, Springfield, Pa. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

The coating consists of a resinous condensation product of diphenylol propane and a halodrin, an amine resin, and a substituted benzoic acid curing agent selected from the group comprising salicylic acid, 5-chlorosalicylic acid, and acetyl salicylic acid. The amine resin can be a butylated urea formaldehyde, a melamine, or a n-propanol modified urea.

Ethylene Vinyl Acetate Polymerization Process. No. 2,703,794. Milton J. Roedel, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

A low temperature continuous process comprising the reaction of 1-30 moles of ethylene per mole of vinyl acetate, 0.5-10 parts of water by weight, 0.1-0.5 parts by weight of tertiary butyl alcohol per part by weight of water, an emulsifying agent, and a peroxygen compound capable of generating free radicals in situ. The reaction is maintained at a temperature of 30-90° C. and a pressure of 50-1500 atmospheres, while continuously drawing off the copolymer as it is formed.

Solution of Nitrocellulose and Triallyl-pentaerythritol Ethyl Carbonate. No. 2,703,763. Stanley F. Marrian, Dunmury, Northern Ireland, and William Henry Thompson, Androssan, Scotland. (to Imperial Chemical Industries, Ltd., Great Britain.).

A liquid nitrocellulose composition, which dries rapidly to form tack-free films that can be polymerized while retaining the nitrocellulose in solution, comprises nitrocellulose and triallyl pentaerythritol ether ethyl carbonate in a low boiling solvent; the ratio being about 10:1 of nitrocellulose to ester.

Reversible Oxidizable and Reducible Phenolic Resins. No. 2,703,792. Edward L. Kropa, Old Greenwich, and Richard P. Welcher, Greenwich, Conn. (to American Cyanamid Co., New York, N. Y.).

The composition contains a granular, infusible, water-insoluble condensed hydroquinone, a phenol, and an aldehyde. Molar proportions of hydroquinone to phenol are 5-20:1, and aldehyde to hydroquinone are 1-4:1. The condensation product is reversibly oxidizable and reducible in an aqueous medium.

The second composition contains a compound with a reactive vinylidene group, a condensed aldehyde-reactive resin, an organic aldehyde resin reversibly oxidizable and reducible, and an aldehyde. The molar proportions of the organic to the cross-linking condensed resin are 5-20:1, and aldehyde to organic resin are 1-4:1.

Process for Preparing Interpolymers of SO_2 with Propylene and an Acrylate. No. 2,703,793. Marcus A. Naylor, Jr., Wilmington, Del. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

Thermally stable polymers are prepared by passing a mixture of propylene, sulfur dioxide, alkyl acrylate, tetramethylene sulfone, and a catalytic quantity of a,a'-azo-bis-iso-butyronitrile into a reaction vessel, and carrying out continuous polymerization at temperatures from 60-90° C.

Vinyl Chloride Polymers Plasticized with Polycarboxylates. No. 2,703,791. John M. Butler, Dayton, O. (to Monsanto Chemical Co., St. Louis, Mo.).

The resin comprises a vinyl chloride polymer plasticized with a condensation product which contains an aliphatic mono-olefinic hydrocarbon and alkyl groups.

Metallic Finish Laminated Sheet Material and Process of Making Same. No. 2,702,580. Alva Wayne Bateman, Newburgh, N. Y. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

The sheeting comprises a flexible base material with a vinyl chloride surface; an intermediate adhesive layer being a tripolymer consisting of 80-90% vinyl chloride, 7-19.7% vinyl acetate, and 0.3-3.0% alpha beta olefinic unsaturated carboxylic acid, and an alkyl acrylic polymer; and a surface layer film of polymeric linear terephthalate metallized on one side.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.

—The Editor

Protein, Ligno-Cellulose-Fatty-Oil Resin. No. 2,702,754. Tatapudy Venkata Subba Rao and Nadipuram Desikachar, Tatapuram, India. (to Tata Oil Mills Co., Ltd., Bombay, India).

The water-resistant molding compound consists of a protein and fatty oil bearing seed cake (such as peanut, cotton, or soya) and lignin material (sawdust, bagasse, peanut hulls, etc.); proportions being 11-33% protein, 6-30% lignin, and 0.5-7.5% fatty oil. A hydrolyzing catalyst and water in the ratio of 3-10:1 are added, and the resulting mixture is subjected to 150-285° C. and a pressure of 50 psi. for approximately five minutes.

Polymerization Products of N-(2-Pyridyl)-Beta-Cyano Acrylic Amides. No. 2,703,317. Gaetano F. D'Alelio, Pittsburgh, Pa. (to Koppers Co., Inc., Pittsburgh, Pa.).

An n-pyridyl amide of beta-cyano-acrylic or beta-cyano-methacrylic acid and a monomer having a $CH_2{=}C<$ group are polymerized. The resulting product has acid-reactive groups.

EQUIPMENT

Hydraulic Extrusion Press. No. 2,702,409. David G. Loomis, Newark, N. J.

The frame includes a pair of spaced, elongated bars with a cross member to hold the extrusion die. A spring-pressed head is at the opposite end of the frame with a material-filled removable cylinder mounted on the frame between the head and the die. A hydraulic ram, axially aligned with the cylinder, is operable through the head, forcing the material out of the cylinder and through the extrusion die.

Apparatus for Forming and Depositing Masses of Plastic Material. No. 2,703,537. Clarence W. Vogt, Norwalk, Conn.

The apparatus comprises a plurality of molding units mounted for movement in a closed path, and having openings in a single plane. The plastic material enters the molds and is moved along the closed path by support elements whose edges are in a plane parallel to the openings.

Apparatus for Cutting Sheets of Plastic Film. No. 2,703,612. Norman H. Nye and Ralph W. Penn, Cuyahoga Falls, and Clarence C. Ensinger and Charles H. Sorrick, Jr., Kent, O.

The machine consists of a rotatable reel for winding the material; a clamping means for securing the strip to the reel; a cutter bar and support; and a means for engaging, locking, and releasing the reel and clamp.

PROCESSING

Method of Impregnating Fiber Insulation Board. No. 2,702,761. Carl P. Mannheim, Livingston, N. J. (to Celotex Corp., Chicago, Ill.).

Porous sheet material is impregnated to different degrees of saturation in different sections by applying localized heat to preselected portions of the sheet which is then immersed in hot, fluid thermoplastic saturant for a pre-determined time.

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Patent Digest (Cont'd.)

Process for Stabilizing a Polyurethane. No. 2,702,797. John S. Rugg, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

The scorching properties of elastomers, such as polytetramethylene ether glycol-toluene diisocyanate polymers, are improved by the addition of a nitrogen base and extending the chain by reaction with water. The material is then milled for 10-60 minutes at a temperature of 300-360° F., and a curing agent added.

Extrusion of Thermoplasic Materials. No. 2,702,408. Derek Hartland, Penn, Wolverhampton, England. (to Union Carbide & Carbon Corp., New York, N. Y.).

Thermoplastic material is heated to molding consistency and introduced into an extrusion die having two distinct temperature zones; the temperature at the die tip being such as to impart the desired surface finish, ranging from matte to gloss.

Method of Working and Extruding Plastic Compounds. No. 2,702,410. Grant S. Brown, Downers Grove, Ill. (to Western Electric Co., Inc., New York, N. Y.).

The method comprises advancing granular plastic material through an extruder, and compacting the material so that entrapped air may be forced backwards. The material is heated to fusion in passage, and extruded.

Process for Forming and Embossing Thermoplastic Materials. No. 2,702,411. Thomas W. Winstead, Baltimore, Md.

The material is spaced between a heating and an embossing surface, and a vacuum is created between the material and the heating surface. This creates a vacuum on the other side, and when the first vacuum is released, the material is forced onto the embossing surface to receive impressions.

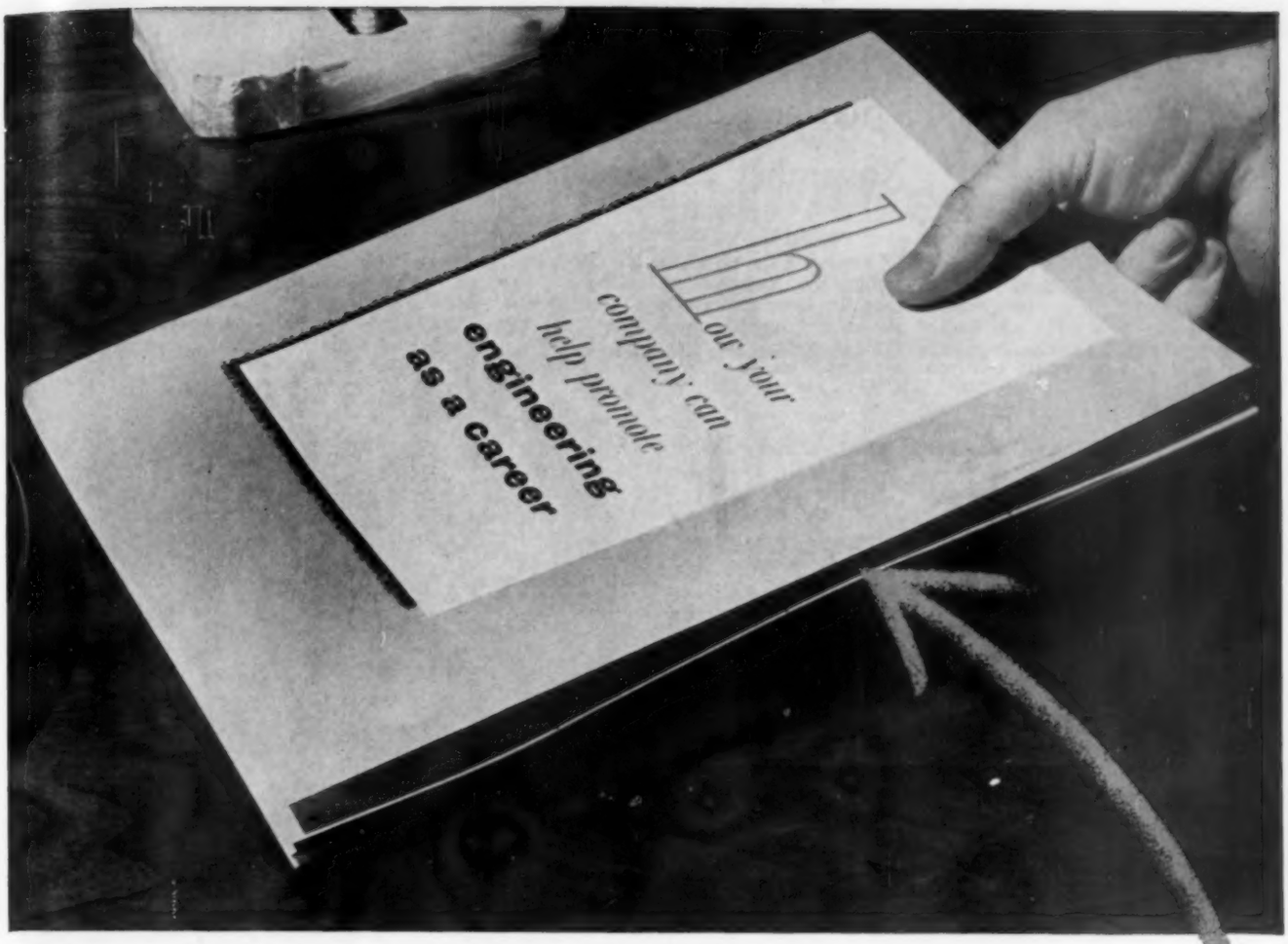
APPLICATIONS

Flexible Plastic Container. No. 2,704,075. Arthur Cherkin, Glendale, Calif. (to Don Baxter, Inc., Glendale, Calif.).

A lay-flat plastic container consisting of a plastic tubing body whose sides are sealed at opposite ends to form a container, with a thickened pad at the lower end for self-sealing. The pad holds a needle for piercing the seal.

Welded Plastic Reflector Units and the Manufacture Thereof. No. 2,703,773. Jonathan C. Stimson, Evanston, Ill. (to Elastic Stop Nut Corp. of America, Union, N. J.).

The unit comprises a thermoplastic rim encircled by a thermoplastic flange which is fusion welded to the outer perimeter of the rim, forming a permanent hermetic seal. This is accomplished by applying heat and pressure to the faces along the edge of the seam, thereby creating surface flow and fusion.



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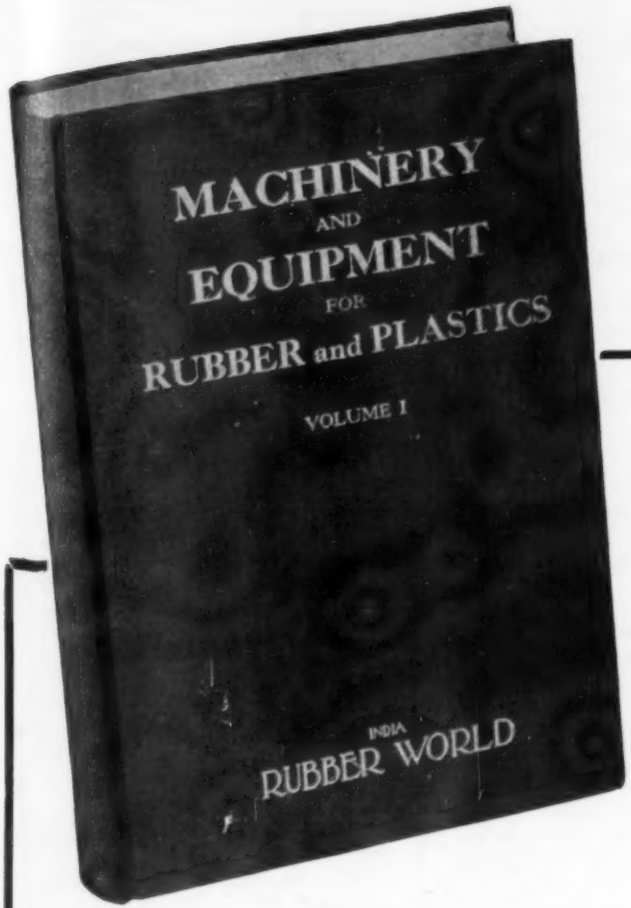
Domestic Production and Sales of Plastics and Resin Material, November and December, 1954

Following are the revised, final November figures and the preliminary, estimated December 1954 statistics for domestic production and sale of plastics and resinous materials. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included as their use is primarily limited to the protective coating industry.

December figures reveal very few changes. Molded and extruded cellulosic materials lost ground, and vinyls show a slight increase.

	NOVEMBER		DECEMBER	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,440,704	1,640,744	1,811,467	1,422,203
Sheets, 0.003 gage and over	1,130,829	1,206,500	1,294,223	1,218,296
All other sheets, rods, and tubes	524,391	545,807	556,437	485,752
Molding and extrusion materials	7,349,725	7,428,040	6,469,934	6,267,549
Nitrocellulose sheets, rods, and tubes	315,947	390,334	329,106	400,452
Other cellulose plastics	508,377	386,704	451,918	433,302
TOTAL	11,269,973	11,598,159	10,913,085	10,227,554
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	14,723,825	15,540,741	14,814,249	14,998,261
Bonding and adhesive resins for—				
Laminating (except plywood)	5,428,658	3,931,598	5,068,584	3,200,844
Coated and bonded abrasives	1,099,794	1,196,370	990,252	1,111,783
Friction materials (brake linings, clutch facings, and similar materials)	1,508,155	1,404,941	1,652,842	1,392,741
Thermal insulation (fiber glass, rock wool)	3,238,273	3,511,021	3,372,080	3,458,390
Plywood	3,202,244	3,035,879	3,160,192	3,110,255
All other bonding and adhesive uses	944,968	1,033,013	1,122,360	1,095,370
Protective-coating resins, unmodified and modified except by rosin	2,015,746	1,669,677	1,792,122	1,562,234
Resins for all other uses	2,747,481	2,463,199	2,829,395	2,810,589
TOTAL	34,909,144	33,786,439	34,802,076	32,740,467
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	3,202,054	3,199,596	3,689,311	3,616,746
Paper-treating and paper-coating resins	1,633,692	1,697,991	1,836,581	1,805,929
Bonding and adhesive resins for—				
Plywood	7,403,033	6,577,595	6,273,823	6,677,690
All other bonding and adhesive uses, including laminating	2,816,943	2,580,264	2,858,923	2,652,429
Protective-coating resins, straight and modified	2,491,074	2,020,686	2,682,443	2,247,734
Resins for all other uses, including molding	6,225,767	6,470,252	5,685,794	5,622,876
TOTAL	23,772,563	22,546,384	23,026,875	22,623,404
Styrene Resins:				
Molding materials[1]	30,229,256	28,099,117	28,150,502	26,958,329
Protective-coating resins, straight and modified	6,922,181	6,925,854	6,543,791	7,732,241
Resins for all other uses	6,265,291	5,969,394	7,054,559	6,602,706
TOTAL	43,416,728	40,994,365	41,748,852	41,293,276
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for—				
Film (resin content)	....	6,856,700	....	6,087,286
Sheeting (resin content)	....	4,131,709	....	5,963,145
Molding and extrusion (resin content)	....	14,057,107	....	14,849,788
Textile and paper treating and coating (resin content)[3]	....	4,536,696	....	4,548,223
Flooring (resin content)	....	4,099,058	....	3,795,968
Protective coatings (resin content)	....	2,130,621	....	2,066,473
All other uses (resin content)	....	3,653,266	....	3,267,542
All other vinyl resins for—				
Adhesives (resin content)	....	2,235,423	....	1,866,579
All other uses (resin content)	....	7,318,260	....	6,921,099
TOTAL	46,531,997	49,018,840	49,772,577	47,366,103
Coumarone-Indene and Petroleum Polymer Resins	18,670,357	18,094,881	17,061,143	17,229,298
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1,4]	22,196,116	17,523,028	24,358,492	17,057,791
Protective-coating resins[5]	255,249	232,959	380,051	282,756
Resins for all other uses[6]	11,008,286	12,825,973	11,746,310	11,487,054
TOTAL	33,459,651	30,581,960	36,484,853	28,827,601
GRAND TOTALS	212,030,413	206,621,028	213,809,494	200,307,703

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, polyethylene, nylon, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.
SOURCE: United States Tariff Commission, Chemical Division.



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CALENDAR of COMING EVENTS

April 27
Reinforced Plastics Group, SPE New York Section. McGinnis' Restaurant, Jamaica, N. Y.

May 3
SPE Southern California Section. Scully's Restaurant, Los Angeles, Calif.

May 4
SPE Western New England Section.

May 7-15
Annual conference, Society of the Plastics Industry, Inc. Cruise to Bermuda, B. W. I.

May 10
SPE Cleveland-Akron. Spanish Tavern, Brecksville, O.

May 11
SPE Newark Section, Military Park Hotel, Newark, N. J.

May 13
SPE Connecticut Section, Hotel Barnum, Bridgeport, Conn.

May 16
SPE Southern Section, Atlanta, Georgia.
SPE Upper Midwest Section. Andrews Hotel, Minneapolis, Minn.

May 16-20
National Materials Handling Exposition, Chicago, Ill.

May 17
Elastomer & Plastics Group, ACS Northeastern Section. M.I.T., Cambridge, Mass.

May 18
SPE New York Section. Gotham Hotel, New York, N. Y.

May 19
Joint meeting, SPE Eastern New England Section and SPI Boston-Providence Chapter.
SPE Ontario Section. St. Regis Hotel, Toronto, Ont. Canada.

May 20
SPE Buffalo Section. Park Lane Restaurant, Buffalo, N. Y.

May 24
SPE Philadelphia Section. Benjamin Franklin Institute, Philadelphia, Pa.

May 25
Reinforced Plastics Group, SPE New York Section. McGinnis' Restaurant, Jamaica, N. Y.
SPE Quebec Section. Queens Hotel, Montreal, Que., Canada.

May 26
SPE Newark Section. Annual Outing. Mazda Brook Farms, Parsippany, N. J.

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News of Industry (Cont'd. from page 174)

Marblette Expansion Program

A half-million-dollar expansion of research, production, and administrative facilities has been launched by Marblette Corp., Long Island City, N. Y. With completion expected on July 1, the program calls for the addition of 15,000 square feet to the existing structures.

The new addition will house research laboratories and administrative offices, freeing a correspondingly large plant area for the production of Marblette epoxy and phenolic resins.

Stix Adhesive-Backed Vinyl

A new, self-adhering vinyl sheeting material for home decoration has been introduced by Stix Products, Inc., an affiliate of Vivitex Corp., New York, N. Y. Called Stix, it can be applied directly to walls, furniture, and other home accessories on removal of the protective paper backing.

Available in 36 design and color combinations, Stix is formulated from Velon, a product of Firestone Plastics Co., Pottstown, Pa. A special innovation is being offered in "Cedar-Odor" Stix which is impregnated with the scent of cedar in addition to resembling the wood in color and pattern.

Chem Plants Set Safety Mark

The chemical industry achieved a new all-time safety record in 1954, according to the Manufacturing Chemists' Association. Lost-time accidents amounted to 3.27 per million man-hours worked, an 11% improvement over the previous year. The accident severity rate declined to 0.49 per thousand man-hours, a 40% reduction.

This accident rate is less than one-third the 11.50 overall rate for manufacturing in general, as shown in the preliminary figures released by the Bureau of Labor Statistics. Ranked as one of the safest industries in the country, the chemical industry has reduced its number of accidents by 57% since 1946.

Monsanto Producing Polyethylene

The commercial production of polyethylene at its Texas City, Tex., plant has been announced by the plastics division of Monsanto Chemical Co., Springfield, Mass. The products will be marketed under the tradename Orizon.

According to sales manager E. S. Childs, the resin is made by a high pressure process, but Monsanto is conducting extensive research into a low presssure polymerization technique which will provide material having a higher heat distortion point, permitting sterilization, and increased strength.

As production increases to capacity level, the company expects to offer a full line of Orizon resins and compounds suitable for use in bottles, coatings, film, wire insulation, cable jacketing, and pipe. Monsanto is placing emphasis on the development of new applications and new resins in anticipation of increased competition as additional suppliers of polyethylene enter production.

Current Market Prices

This listing is as comprehensive and up-to-date as possible. The full listing will appear quarterly, while intervening issues will carry a briefer tabulation of price changes and additions.

Companies whose products do not appear are invited to submit price data for inclusion in the listing. All suppliers are requested to submit product additions and price changes promptly as they occur, in order to make this listing of maximum value to our readers.

Prices, in general, are f.o.b. works. Ranges indicate quantity or grade variations. No guarantee of these prices is made, and spot prices should be obtained from the individual suppliers.

—The Editor

Adhesives

Ampcoflex Adhesive	qt.	$2.75 /	$3.50
Bakelite BC—17613	lb.	.54	.84
BCU-40	lb.	.18	.48
BR-11938	lb.	.285	.585
Bonding resins, abrasives	lb.	.20 /	915
Brake linings	lb.	.215	.6275
Foundry resins	lb.	.2075	.395
Heat Insul. resins	lb.	.1425	.37
CD Cement Nos. 200, 201, 202, 203, 204	qt.	$0.94 /	$1.50
PS-7	qt.	2.12 /	2.90
Epoxy Adhesive A-1, A-3 A-4	qt.	4.45 /	6.90
A-2, A-5	qt.	5.60 /	8.00
A-6	qt.	5.80 /	8.00
C-1, C-2, C-3, C-9	qt.	5.60 /	8.00
C-4, C-7	qt.	3.69 /	5.30
Flexible Resin No. 1	qt.	4.45 /	6.90
G-E 12316	lb.	.2975/	.3975
Melmac 401	lb.	.45	
421	lb.	.45 /	.47
Melurac 300, 302	lb.	.25 /	.29
301	lb.	.28 /	.33
Metlbond 2002-14	qt.	1.84 /	5.00
4021 Type I	sq. ft.	1.43	
Type II	qt.	1.29 /	3.20
Type III	qt.	1.49 /	3.50
Plaskon Phenolic Bonding Resin	lb.	.16 /	.21
Urea Adhesive 530-11L	lb.	.1875/	.2175
Liquid Adhesive, 2L Types	lb.	.105 /	.115
WR Types	lb.	.0675/	.125
Spray Dried Adhesives	lb.	.18 /	.29
Schenectady SP-7401	lb.	.29 /	.31
Schwartz Vinyl Cement	qt.	1.24 /	1.50
Urac 110	lb.	.205 /	.225
115	lb.	.27 /	.29
180	lb.	.105 /	.125
185	lb.	.1875/	.2275
186	lb.	.0825/	.1075
192	lb.	.65	

Anti-Static Agents

Anstac-2M	qt.	1.75 /	2.00
Logostat	gal.	1.35 /	1.65
Merix Anti-Static	qt.	1.60 /	4.00

Catalysts

Advasol	lb.	.4375/	.5375
Aritemp Curing Agent 105	lb.	2.00 /	2.25
Bakelite BH-17618	lb.	.33 /	.63
BHU-53	lb.	.15 /	.45
ERL series	lb.	.67 /	1.195
Cadet benzoyl peroxide, granules	lb.	.98 /	1.13
Paste	lb.	.95 /	1.35
Powder	lb.	1.50	
Dichlorobenzoyl peroxide	lb.	4.50 /	4.95
Lauroyl peroxide	lb.	1.90 /	2.30
Methyl ethyl ketone peroxide	lb.	1.85 /	2.50
Catalyst 57	lb.	.12	
196	lb.	.10	
C-110, -180, -180-S, C-110-S, WF-100, -101	lb.	.12	
Curing Agent A	lb.	3.00 /	6.75
B	lb.	3.00 /	4.75
Furane H-736-A	lb.	1.30 /	2.00
Hardener 157	lb.	1.00 /	1.15
175, 179, 191	lb.	.50 /	.65
181, 184, 185, 185-S, M-325	lb.	.12	
342	lb.	1.40 /	1.55
H C Promoter 6%	lb.	.5275/	.6275
12%	lb.	.9025/	1.0025
HN 551	lb.	.95 /	1.40
901	lb.	.36 /	1.80
951 Ciba	lb.	.82 /	2.37
951 Furane	lb.	1.30 /	2.00
Melurac 255, 259	lb.	.35	
Modifier CB-110,WF-61	lb.	.15	
Plaskon Hardeners, Liquid	lb.	.07	
Powdered	lb.	.10 /	.46
Spray dried	lb.	.10 /	.25
Promoter D-2	lb.	1.60 /	2.00
SA Hardener	lb.	.10	
Shell ditertiary butyl peroxide	lb.	1.965 /	2.92
Soligen	lb.	.4825/	.5825

Coating Resins

Bakelite Phenolics	lb.	.28 /	.64
Styrene emulsions	lb.	.1375/	.31
Vinyl acetates	lb.	.295 /	.66
Solutions	gal.	5.10	
Alcohols	gal.	2.27 /	2.76
Butyral resins	lb.	1.04 /	1.24
Chlorides	lb.	.41 /	.61
Chloride-acetates	lb.	.38 /	.66
Modified	lb.	.44 /	.72
CD Strip A	qt.	1.13 /	2.10
Dylex K-500, -600, -700, -900	lb.	.30 /	.46
Kel-F Dispersion (dry wt.)	lb.	12.00	
Plaskon Alkyds	lb.	.1075/	.3375
Modified	lb.	.15 /	.2625
Ester Gums	lb.	.1425/	.2475
Maleics	lb.	.1825/	.275
Melamines	lb.	.195 /	.435
Phenolics	lb.	.3925/	.475
Modified	lb.	.1825/	.29
Phenolic Laminating Varnishes	lb.	.165 /	.27
Silicone Alkyds	lb.	1.10 /	2.40
Ureas	lb.	.195 /	.435
Schenectady Alkyds SA Type	lb.	.3575/	.38
SE Type	lb.	.3675/	1.435
SEA Type	lb.	.3575/	.38
Styrenated	lb.	.22 /	.2625
Maleics	lb.	.1725/	.23
Phenolics	lb.	.2325/	.53
Modified	lb.	.1825/	.275
Schwartz AT-25	qt.	.63 /	1.00
BE-40	gal.	3.80 /	3.95

Colors

Aquablaks	lb.	.085 /	.235
Cabot carbon blacks	lb.	.05 /	.79
Cadmolith Reds	lb.	1.72 /	2.20
Yellows	lb.	1.12 /	1.20
Claremont 4000-series Pastes Blacks	lb.	.82 /	1.01
Blue	lb.	.80	
Browns	lb.	.65 /	2.30
Greens	lb.	.80 /	2.15
Orange	lb.	1.58	
Red	lb.	4.15 /	4.80
Silver	lb.	1.02	
White	lb.	.695	
Yellows	lb.	.65 /	2.87
D-Series pastes, Blacks	lb.	.47 /	.68
Blues	lb.	.62 /	1.55
Golds	lb.	2.31 /	2.49
Green	lb.	1.86 /	1.88
Oranges	lb.	.70 /	3.65
Reds	lb.	1.10 /	2.57
Silver	lb.	.89 /	.91
Whites	lb.	.45 /	.60
Yellows	lb.	.55 /	1.68
K-Series pastes, Blacks	lb.	.58 /	.71
Blues	lb.	.91 /	1.40
Browns	lb.	.53	
Greens	lb.	.94 /	1.41
Metallics	lb.	.91 /	2.47
Orange	lb.	.80 /	3.84
Reds	lb.	1.03 /	5.07
Violet	lb.	2.30	
Whites	lb.	.59 /	.60
Yellows	lb.	.73 /	3.02
Codispersions	lb.	.23 /	.24
Covinylblaks	lb.	.68 /	1.145
Cowaxblaks	lb.	.4075/	.6075
Cyanamid organic pigments	lb.	.79 /	.90
Ferro blues, browns, greens	lb.	.90 /	2.96
Reds	lb.	2.93 /	4.75
Yellows	lb.	.91 /	2.90
IVO bone blacks	lb.	.16 /	.2175
Kentucky inorganics, orange	lb.	.44 /	.64
Yellows	lb.	.31 /	.66
Organics, blues	lb.	3.00 /	4.15
Greens	lb.	3.50 /	4.60
Purple	lb.	1.85 /	2.05
Reds	lb.	1.95 /	3.85
Kralastic standard colors	lb.	.50 /	1.10
Kriegr-O-Dip W Types	qt.	2.63 /	7.80
A Types	qt.	1.52 /	2.25
Laminac color pastes	lb.	.66 /	1.90
Mapico blacks, crimsons, reds	lb.	.1275/	.13
Browns	lb.	.1375/	.14
Tans	lb.	.2025/	.205
Yellows	lb.	.105 /	.1125
Mearlmaid Pearls	lb.	14.00 /	25.00
Nacromer Pearls, Series C	lb.	2.15 /	2.25
Series W	lb.	1.50 /	1.60
PMS polyester colors	lb.	.85 /	2.85
Polystyrene colors	lb.	.65 /	4.30
Polysupra polyethylene blues	lb.	.65 /	5.60
Blacks	lb.	.50 /	.80
Browns	lb.	1.48 /	3.30
Greens	lb.	1.82 /	3.55
Ivory	lb.	.65 /	1.00
Purples	lb.	2.10 /	3.30
Reds	lb.	.70 /	6.30
Silver	lb.	1.50 /	2.95
White	lb.	.60 /	.85
Yellow	lb.	1.45 /	4.25
Polystyrene blues	lb.	.50 /	9.20
Blacks	lb.	.50 /	5.30
Browns	lb.	.95 /	2.55
Greens	lb.	.35 /	7.40
Ivory	lb.	.85 /	1.20
Reds	lb.	.35 /	6.40
White	lb.	.60 /	1.05
Yellows	lb.	1.45 /	2.95
R-C blacks	lb.	5.50 /	21.30
Browns	lb.	4.375 /	15.75
Reds	lb.	.28 /	15.05
Yellows	lb.	3.60 /	14.05
Rez-N-Dye (dry wt.)	lb.	7.50	
Saran colors	lb.	.59 /	1.80
Sherwin-Williams Dispersed Colors	lb.	.55 /	1.97
Inorganic colors, oranges, yellows	lb.	.32 /	.45
Organic colors, blues	lb.	.90 /	3.60
Greens	lb.	1.35 /	3.95
Reds	lb.	.85 /	4.40
Yellows	lb.	.55 /	1.97
Vinylized colors, blacks, whites	lb.	.755	
Blues	lb.	1.16 /	1.18
Golds	lb.	1.51 /	1.57
Green	lb.	1.45	
Metallic	lb.	1.15	
Orange	lb.	.83	
Reds	lb.	1.15 /	2.27
Yellows	lb.	.76 /	1.09
Violite 199, green	lb.	2.95	
200, yellow	lb.	3.75	
PL 3-60, blue	lb.	3.25	
18-70, blue	lb.	3.70	
Witcoblaks	lb.	.075 /	.37
Zopaque, anatase	lb.	.225 /	.235
Rutile	lb.	.245 /	.255

Dispersing Agents

Daxads	lb.	.08 /	.40

Fillers

Cab-o-sil	lb.	.68 /	.75
Calcene NC	lb.	.036 /	.059
TM	lb.	.0375/	.0625
Cotton flocks	lb.	.12 /	.32
Dixie Clay	ton	14.00 /	34.50
Hi-Sil 101	lb.	.10 /	.155
233	lb.	.09 /	.105
Kalite	ton	50.00 /	65.00
McMamee Clay	ton	13.50 /	33.00
Multifex MM	ton	110.00 /	125.00
Nytal 200L	ton	27.00 /	50.00
300	ton	37.00 /	60.00
Silene EF	lb.	.06 /	.105
Surfex MM	ton	37.00 /	52.00
Suspenso	ton	33.00 /	48.00
Witcarb P	ton	110.00 /	140.00
R	ton	120.00 /	150.00
Regular	ton	56.75 /	85.00
Wollastonite F-1	ton	23.00 /	25.00
P-1	ton	25.00 /	27.00

Finishes

Toy Gloss T-11 H	gal.	2.75 /	4.45
Logoquant colors	gal.	3.35 /	11.95
Silk screens	gal.	1.50 /	6.11
Logoset Series W	gal.	1.72 /	7.64

Flame-Proofing Agents

M&T Antimony Oxide	lb.	.29 /	.305
Flame Retarder	lb.	.29 /	.305

Lubricants

Baselube	qt.	2.50 /	4.00
Bomb-Lube	lb.	1.35 /	1.95
DC-36 Emulsion	lb.	1.36 /	2.50
Garalease 915	gal.	3.80 /	4.50
Lunn-Lease	gal.	4.15 /	4.85
M-1 Mold Release	lb.	3.00 /	4.00
Metasap barium stearate	lb.	.37 /	.42
Calcium 627	lb.	.36 /	.41
Stearate	lb.	.35 /	.40

Magnesium stearate	lb.	.38 /	.43
Mold-Ease Concentrate PCR	qt.	2.50 /	5.85
Mold Release 225	gal.	5.25 /	6.00
235	gal.	6.00	
Part-A-Part	gal.	3.05 /	3.75
Partingkote No. 823	qt.	1.18 /	4.36
Prepoxy No. 832 A	qt.	2.85 /	3.00
Plastik Parting Fluid No. 829	qt.	2.18	
Releasor Wax No. 826	lb.	2.29	
SS-452	gal.	2.80 /	4.90
Toplube	qt.	2.50 /	4.00
Vibrin-VPA Parting Agent	gal.	4.25 /	4.65

Miscellaneous

Advaresin C X F	lb.	.49 /	.55
K F	lb.	.40 /	.46
Dutch Boy Bentone	lb.	.44 /	.60
Ben-A-Gel	lb.	.98 /	1.40
Metasap Water Proofing Agent 569	lb.	.21	
PMS Purging Compound	lb.	.35	

Molding Compounds & Resins

Acrylic

Cadco cast rods	lb.	1.83 /	6.96
Polished	lb.	1.99 /	7.16
Machined rods	ft.	22.00 /	89.54
Tubes	lb.	1.39 /	5.76
Polished	lb.	1.51 /	5.99
Colors	lb.	1.62 /	5.99
Pearl	lb.	1.99 /	6.76
Lucite injection molding powders:			
Colorless, transparent	lb.	.68 /	.80
Std. colors	lb.	.72 /	1.00
Compression molding powders	lb.	.65 /	.75
Plexiglas molding powders:			
Colorless	lb.	.65 /	.835
Colors, std.	lb.	.69 /	1.035
Stock	lb.	.69 /	.885
Sheets, Types I-A & II			
Colorless	sq. ft.	.80 /	43.61
Colored	sq. ft.	.88 /	1.82
Type R: colorless	sq. ft.	.60 /	1.04
Colored	sq. ft.	.87 /	1.33

Alkyd

Plaskon foundry resin 580-11L	lb.	.245 /	.275
Molding compound, Type 411	lb.	.43 /	.60
Type 413, 417	lb.	.57 /	.74
Type 420 black	lb.	.44 /	.695
Type 422 colored	lb.	.51 /	.695
Mottle	lb.	.52 /	.705
Natural	lb.	.49 /	.60
Type 430	lb.	.34 /	.50

Cellulosic

Cellulose acetate:			
Ampacet Group I	lb.	.50 /	.59
Group II	lb.	.46 /	.55
Group III			
Colors	lb.	.50 /	.59
Metallic	lb.	.63 /	.71
Pearl	lb.	.59 /	.68
Phosphorescent	lb.	.80 /	.89
Celanese film rolls			
Clear	lb.	.64 /	.87
Colors	lb.	.88 /	1.74
Sheets			
Clear	M. sq. in.	.032 /	.107
Colors	M. sq. in.	.042 /	.141
Lumarith molding cmpds.,			
Group I	lb.	.50 /	.59
Group II	lb.	.46 /	.55
Group III	lb.	.42 /	.51
Sheeting, extruded, non-stock			
Clear	lb.	.12 /	1.89
Colors	lb.	.15 /	2.07
Stock, clear	M. sq. in.	.12 /	1.62
Colors	M. sq. in.	.14 /	1.62
Cast, rolls			
Clear	M. sq. in.	.125 /	.558
Matte	M. sq. in.	.179 /	.648
Tinted	M. sq. in.	.239 /	.708
Sheets, clear	M. sq. in.	.141 /	1.52
Matte	M. sq. in.	.203 /	.788
Tinted	M. sq. in.	.255 /	1.72
Hercocel A, extrusion & injection	lb.	.50 /	.65
Injection, std. colors	lb.	.46 /	.61
Special colors	lb.	.42 /	.45
Tenite Acetate, Group 1	lb.	.50 /	.59
Group 2	lb.	.46 /	.55
Group 3	lb.	.41 /	.51
Group 4	lb.	.38 /	.49
Group 5	lb.	.65 /	.75
Cellulose acetate butyrate:			
Tenite butyrate	lb.	.62 /	.71
A pearls	lb.	.72 /	.81
Blacks, reprocessed	lb.	.50 /	.58
Ethyl cellulose:			
Dyeform 720, 721	lb.	1.29 /	1.52
Ethocel P. G.	lb.	.72 /	.80
Bulk, reg.	lb.	.66 /	.81
Std., 7 cps.	lb.	.71 /	.86
Hercocel E	lb.	.72 /	.88

Epoxy

Araldite 502, 504, 6020, 6030	lb.	.905 /	1.51
551	lb.	.75 /	1.20
552	lb.	.72 /	1.22
6060	lb.	.75 /	1.20
Bakelite ERL series	lb.	.80 /	.995
Epocast 2, 3, 5	lb.	1.33 /	1.77
4-B-2, 4-B, 4-C, 4-C-T, 4-D, Paste	lb.	1.15 /	1.55
Epon 828	lb.	.80 /	1.21
834	lb.	.90 /	1.56
864	lb.	.91 /	1.44
864-C-75	lb.	.73 /	.74
1001	lb.	.615 /	1.56
Furane CN-502	lb.	1.33 /	1.77
Jet-Kote (with cat.)	gal.	7.50 /	10.00
Rezolin L-900	lb.	1.33 /	2.19
L-910	lb.	1.42 /	2.19
L-930	lb.	1.51 /	2.19
L-940, -941, -942	lb.	1.52 /	2.19

Fluorocarbon

Bakelite FGBB-33789, FGEB-34790, FXMA-50590, FXMB-50344	lb.	9.00 /	10.00
FGEB-32788, FXMB-50090	lb.	12.00 /	14.00
FYTD	lb.	11.00 /	13.00
FYTH, FYTS	lb.	8.50 /	9.50
Kel-F Grade 270, 300			
High density	lb.	9.00 /	10.00
Low density	lb.	8.50 /	9.50
Grade 300-P25	lb.	10.00 /	11.00
Polyfluoron granules, high density	lb.	9.00 /	10.00
Powder, low density	lb.	8.50 /	9.50
Dispersion grade	lb.	10.50 /	11.50
Teflon powder, dispersion	lb.	7.00 /	7.75
Fine	lb.	9.50 /	11.00
General	lb.	5.10 /	5.75
Tape cylinder	lb.	5.35 /	6.00

Melamine

Fiberite 2016	lb.	.95	
Melmac 402	lb.	.51 /	.53
404R, 404T	lb.	.85 /	.95
405	lb.	.45 /	.52
428	lb.	.48 /	.55
430	lb.	.465 /	.535
440	lb.	1.10	
480	lb.	.265 /	.315
1077, 1079	lb.	.47 /	.75
1500	lb.	.42 /	.55
1502	lb.	.45 /	.58
3020	lb.	.57 /	.72
3024-A	lb.	.67	
3135	lb.	.90 /	1.10
P-592, -592-A	lb.	.65 /	.75
Plaskon	lb.	.44 /	.75

Phenolic

91-LD	lb.	1.50 /	2.50
Admirez PL-50	lb.	.215	
UP-11	lb.	.2325	
Bakelite general purpose	lb.	.187 /	.3525
BMG-5000	lb.	.19 /	.30
Colors	lb.	.2375/	.435
Chem. resist.	lb.	.23 /	.40
Electrical Insul.	lb.	.2725/	.4125
Heat resist.	lb.	.19 /	.35
Impact resist.	lb.	.24 /	.4025
Barrett foundry resins, liquid	lb.	.2125/	.2425
Powdered	lb.	.27 /	.355
Insulation resins	lb.	.15 /	.175
Molding resin 313, 314, 317	lb.	.27 /	.285
316	lb.	.295 /	.31
1502, -3, -4, -5, R-110R	lb.	.25 /	.265
R-114	lb.	.285 /	.30
Corfoam 107, 114	lb.	.55 /	.82
Cyacor 151	lb.	.215 /	.235
191	lb.	.13 /	.16
Durez, heat resist.	lb.	.19 /	.245
Impact resist	lb.	.24 /	.63
Insulation	lb.	.21 /	.305
Non-Bleed	lb.	.19 /	.195
Special	lb.	.19 /	.665
Std.	lb.	.19 /	.245
Durite GP	lb.	.195 /	.24
HR	lb.	.191 /	.3025
IM	lb.	.24 /	.415
SG	lb.	.195 /	.3575
Fiberite 1078	lb.	.42 /	.43
1087, 1165, 1270, 1271, 1330, 1332, 1347, FM 1132, FM 3510	lb.	.39 /	.395
1153	lb.	.455 /	.46
1167	lb.	.3875/	.3925
1340	lb.	.4275/	.4325
1346	lb.	.44 /	.4475
4010	lb.	.68	
4020	lb.	.815 /	.82
FM 926	lb.	.43 /	.435
927	lb.	.41 /	.415
1914	lb.	.375 /	.38
1957	lb.	.445 /	.45
1996	lb.	.375 /	.38
10365	lb.	.5225/	.5275
11547	lb.	1.05 /	1.06
11678	lb.	.52 /	.525
14111	lb.	.415 /	.42
17067	lb.	.851 /	.82
17610	lb.	1.05 /	1.06
G-E 12316 foundry resin	lb.	.2975/	.3975
12368, 12374, 12392 shell mold	lb.	.26 /	.36
12408, 12460, 12490, 12491, 12493, 12853, 12863, 12875 12460	lb.	.19 /	.20
12420, 12439	lb.	1.05 /	1.15
12430, 12817, 128882	lb.	.20 /	.21
12432	lb.	.39 /	.395
12433	lb.	.55 /	.555
12435	lb.	.235 /	.24
12439, 12466	lb.	.26 /	.36
12444	lb.	.42 /	.425
12462	lb.	.50 /	.505
12463	lb.	.40 /	.405
12467	lb.	.50 /	.60
12486	lb.	.195 /	.20
12487, 12489 rubber-phenolic	lb.	.355 /	.36
12494 rubber-phenolic	lb.	.375 /	.38
12495	lb.	.24 /	.245
12808 rubber-phenolic	lb.	.49 /	.495
12809 rubber-phenolic	lb.	.65 /	.655
12824	lb.	.49 /	.495
12841	lb.	.2375/	.2425
Loven LHR-401, -403	lb.	.225 /	.23
-407, -409	lb.	.60 /	1.00
-408	lb.	.25 /	.255
LI201	lb.	.39 /	.40
-207	lb.	.475 /	.48
-209	lb.	.60 /	1.00
-212	lb.	.425 /	.43
LM-110, -119	lb.	.19 /	.195
-101	lb.	.24 /	.245
-116	lb.	.255 /	.26
-117	lb.	.225 /	.23
-118	lb.	.1975/	.2025
LMI-361	lb.	.2525/	.2575
-303	lb.	.345 /	.35
-304	lb.	.60 /	1.00
-307	lb.	.3075/	.3125
LMM-801, -803	lb.	.2125/	.2175
-804, -811	lb.	.245 /	.25
-807	lb.	.215 /	.22
Marblette casting resins	lb.	.50 /	.60
Plenco foundry resins	lb.	.27 /	.35
Molding cmpds., gen. purpose	lb.	.185 /	.235
Heat resist.	lb.	.19 /	.24
Improved impact	lb.	.225 /	.28
Min. bleed	lb.	.185 /	.195
Radio & TV	lb.	.20 /	.215
Stock	lb.	.205 /	.34
Reilly general purpose	lb.	.195 /	.20
Heat & impact resist.	lb.	.20 /	.205
Resinox, gen. purpose, heat resist.	lb.	.19 /	.20
Impact	lb.	.245 /	.3125
Low elec. loss	lb.	.30 /	.355
Special	lb.	.20 /	.24
Rogers RX-425	lb.	.28 /	.385
-426	lb.	.3425/	.3475
-428	lb.	.34 /	.455
-429	lb.	.35 /	.46
-431	lb.	.4075/	.53
-442	lb.	.3325/	.3375
-448	lb.	.34 /	.345
-458	lb.	.365 /	.37
-525	lb.	.28 /	.285
Schenectady shell mold resins	lb.	.26 /	.28
Toolplastik No. 8000	lb.	.48 /	.72

Polyamide

Zytel molding powder	lb.	1.435 /	1.60

Polyester

Atlac 363E-02Z, -12Z	lb.	.66 /	.69
-32Z	lb.	.68 /	.71
382E	lb.	.57 /	.60
FP	lb.	.66 /	.69
Bakelite Polyester resins	lb.	.35 /	.75
Diall 50-01, -51	lb.	3.00 /	3.50
51-01	lb.	.76 /	.90
52-01	lb.	1.88 /	2.50
52-20-30	lb.	1.30	
Hetron	lb.	.43 /	.485
Laminac 4110, 4116, 4123	lb.	.35 /	.365
4111	lb.	.45 /	.465
4119	lb.	.43 /	.445
4120	lb.	.40 /	.415
4128	lb.	.37 /	.385
4134	lb.	.46 /	.475
4146, 4202	lb.	.55 /	.565
4192	lb.	.365 /	.38
Plaskon 911, 920	lb.	.55 /	.665
941, 942, 951, 9411	lb.	.35 /	.465
943	lb.	.41 /	.525
9404	lb.	.365 /	.48
9406	lb.	.355 /	.465
9500, 9510, 9511	lb.	.35 /	.465
9600	lb.	.44 /	.555
Pre-Imp	lb.	.68 /	.85
Thermaflow 100T	lb.	.62 /	1.05
120	lb.	.89 /	1.25
200T, 300T	lb.	.62 /	1.05
400T, 500T	lb.	.70 /	1.10
Vibrin No. 112	lb.	.40 /	.515
114, 117, 118, 151, 152	lb.	.35 /	.465
115A	lb.	.38 /	.495
121	lb.	.46 /	.575
135	lb.	3.00	
142	lb.	.55 /	.665
152	lb.	.365 /	.48
X-1029	lb.	.35 /	.465
X-1055B	lb.	.62 /	.73
X-1633A	lb.	.49 /	.605
X-1636W	lb.	.585 /	.70

Polyethylene

A-C No. 6, 617	lb.	.30 /	.37
No. 6A, 7, 617A	lb.	.35 /	.42
No. 615, G-201	lb.	.38 /	.45
No. 629	lb.	.40 /	.47
No. 729	lb.	.45 /	.52
Alathon	lb.	.41 /	.505
Bakelite DE Series	lb.	.43 /	.725
DVGT	lb.	.54 /	.69
DVLT, DYNF, DYNH	lb.	.41 /	.59
DYNJ	lb.	.44 /	.62

DYNK	lb.	.45 /	.63
Celanese film, rolls	lb.	.61	
Sheets	M. sq. in.	.033 /	.257
Sheeting, rolls	lb.	.85 /	.98
Sheets	lb.	.98 /	1.15
Poly-Eth 1003	lb.	.44 /	.58
1005, 1007	lb.	.41 /	.55
Reynolon 1000, P series	lb.	.60 /	.80
Tenite Group 1	lb.	.41 /	.45
Group 2	lb.	.43 /	.47
Group 3	lb.	.46 /	.50
Group 4	lb.	.39 /	.43
Group 5, 6	lb.	.50 /	.72
Group 7	lb.	.60 /	.82
Group 8	lb.	.70 /	.92

Silicone

Bakelite GMGA-5001, -5002	lb.	2.75 /	3.10
5003	lb.	4.00 /	4.35
5004	lb.	5.40 /	5.75

Styrenes

Ampacet, crystal	lb.	.315 /	.335
Colors, std.	lb.	.345 /	.365
Special	lb.	.345 /	.75
Pearl	lb.	.41 /	.75
Phosphorescent	lb.	.695 /	1.00
Tinsel	lb.	.41 /	.67
Confetti	lb.	.51 /	.70
Bakelite BMC series, nat.	lb.	.45 /	.685
Colors	lb.	.50 /	.735
BMS, SMD series, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	.52
RMD series, nat.	lb.	.45 /	.685
Colors	lb.	.50 /	.735
TGD series	lb.	.33 /	.35
Colors, std.	lb.	.36 /	.38
Special	lb.	.36 /	1.00
TMD series	lb.	.33 /	.40
Colors, std.	lb.	.36 /	.43
Special	lb.	.36 /	1.00
Catalin, high impact, natural	lb.	.325 /	.355
Colors, std.	lb.	.355 /	.385
Special	lb.	.36 /	1.00
Medium impact, natural	lb.	.325 /	.355
Colors, std.	lb.	.355 /	.385
Special	lb.	.355 /	1.00
Regular grade, crystal	lb.	.305 /	.325
Colors, std.	lb.	.345 /	.365
Special	lb.	.345 /	1.00
Utility black	lb.	.18 /	.235
Cycolac 12769 A, 12877, 12968, 12982	lb.	.73 /	.81
12803	lb.	.65 /	.73
12830, 12967	lb.	.70 /	.78
12876 A	lb.	.69 /	.77
12981	lb.	.78 /	.86
12983	lb.	.76 /	.84
12984	lb.	.77 /	.85
13022	lb.	.72 /	.80
Darex Copolymer 3	lb.	.47 /	.67
43G, X34	lb.	.42 /	.61
Latices 3L, 34L, 616L	lb.	.335 /	.48
610L	lb.	.30 /	.46
Dow Latex, polystyrene	lb.	.30 /	.46
Latices, styrene/butadiene	lb.	.30 /	.46
Dylite, expandable beads	lb.	.50 /	.60
Koppers, Fibertuff	lb.	.55 /	1.505
MC-185 series	lb.	.33 /	.355
-300 series	lb.	.33 /	1.005
-400 series	lb.	.355 /	1.005
Regular, crystal	lb.	.295 /	.315
Colors, std.	lb.	.335 /	.355
Special	lb.	.335 /	1.005
Pearl	lb.	.41 /	1.005
Phosphorescent	lb.	.695 /	2.005
Lustrex Hi-Flow 55, crystals	lb.	.295 /	.31
Hi-Test 88, std.	lb.	.36 /	.38
Special colors	lb.	.36 /	1.00
L, crystals	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
LHA, std.	lb.	.355 /	.375
Special	lb.	.355 /	1.00
Utility black, gen. purpose	lb.	.18 /	.185
High impact	lb.	.235 /	.24
Medium impact	lb.	.19 /	.195
Marbon resins	lb.	.39 /	.46
Plio-Tuf G75C, G85C	lb.	.52 /	.55
Styron 475, natural	lb.	.33 /	.35
Colors, std.	lb.	.36 /	.38
Special	lb.	.36 /	1.00
Sheets, std.	lb.	.55 /	.60
Special	lb.	.55 /	.62
480, natural, black	lb.	.38 /	.40
Colors, std.	lb.	.41 /	.43
Special	lb.	.41 /	1.00
647, crystal	lb.	.305 /	.32
Colors, special	lb.	.345 /	1.34
666, 688, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
700, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
777 colors, std.	lb.	.355 /	.375
Special	lb.	.355 /	1.00

Urea

Admirez SP-30	lb.	.27	
UP-50	lb.	.105	
Beetle C-4980, T-298	lb.	.1875/	.30
MUP series, powder	lb.	.30 /	.49
Special colors	lb.	.30 /	.59
Granules	lb.	.33 /	.52
Special colors	lb.	.33 /	.62
Plaskon molding cmpds.:			
Colors, single	lb.	.1875/	.30
Special	lb.	.30 /	.62
Standard	lb.	.30 /	.52
Foundry resins, liquid	lb.	.10 /	.13
Powdered	lb.	.2325/	.2525

Vinyls

Bakelite QG-5909	lb.	.42 /	.655
Colors	lb.	.47 /	.705
QG-5921	lb.	.475 /	.71
5924	lb.	.465 /	.70
QYNA	lb.	.38 /	.58
QYSM, QYSJ, QYSQ	lb.	.40 /	.58
VG-1914, -1918	lb.	.45 /	.685
1985	lb.	.435 /	.67
5707, -9031 colors	lb.	.365 /	.60
5544	lb.	.46 /	.695
5911	lb.	.37 /	.605
Colors	lb.	.42 /	.655
5980, -9530 colors	lb.	.38 /	.615
9031 nat.	lb.	.315 /	.55
9530 nat.	lb.	.33 /	.565
Blacar No. BW-60	lb.	.315 /	.385
NEMA colors	lb.	.355 /	.425
No. BW-80	lb.	.405 /	.455
NEMA colors	lb.	.445 /	.495
No. PC white, ivory, black	lb.	.285 /	.335
Other colors	lb.	.325 /	.375
Darex Everplex A (wet wt.)	lb.	.21 /	.39
B (wet wt.)	lb.	.22 /	.40
G (wet wt.)	lb.	.21 /	.39
Copolymer Y (wet wt.)	lb.	.245 /	.28
PVA Emulsions (wet. wt.)	lb.	.19 /	.355
Diamond PVC-45, -50	lb.	.38 /	.44
Dow PVC-100, -111	lb.	.38 /	.57
Exon 402A, 450, 468, 500, 900A, 905, 915, 925	lb.	.38 /	.56
400XR-61	lb.	9.75	
470	lb.	9.55	
471	lb.	9.50	
654 plastisol	lb.	.41 /	.59
700XR-59 latex	lb.	.38 /	.44
Formvar	lb.	.865 /	1.03
Gelva emulsions	lb.	.19 /	.205
Granules	lb.	.4175/	.6175
Geon color masterbatches	lb.	2.00 /	2.75
Extrusion cmpd. 2042, white ivory	lb.	.375 /	.61
NEMA colors	lb.	.425 /	.66
2046 black	lb.	.375 /	.61
6373 black, white, nat.	lb.	.42 /	.655
NEMA colors	lb.	.47 /	.705
6461 black, white, nat.	lb.	.465 /	.625
Colors	lb.	.515 /	.675
8550 transparent	lb.	.54 /	.67
8600 black, white, ivory	lb.	.405 /	.565
NEMA colors	lb.	.455 /	.615
8620 black, white, ivory, brown	lb.	.405 /	.565
Gray, green, red	lb.	.455 /	.615
8630 black, white, nat.	lb.	.565 /	.725
Colors	lb.	.615 /	.775
8650 black, white, nat.	lb.	.44 /	.60
8656 black, nat.	lb.	.565 /	.725
8677 black	lb.	.545 /	.705
8720 black, gray, nat.	lb.	.735 /	.895
8737 black, nat.	lb.	.435 /	.595
8740 black, white, nat.	lb.	.405 /	.565
Latex 151, 251	lb.	.34 /	.40
351	lb.	.38 /	.44
352	lb.	.36 /	.42
552	lb.	.415 /	.475
576	lb.	.39 /	.45
652	lb.	.41 /	.47
Molding cmpd. 8372 black, white	lb.	.405 /	.64
Colors	lb.	.455 /	.69
8539 black, white, gray, nat	lb.	.42 /	.655
Colors	lb.	.44 /	.675
8640	lb.	.435 /	.67
8643	lb.	.405 /	.64
8679, 8726, 8727, 8728, 8729, 8731	lb.	.42 /	.655
Polyblends	lb.	.475 /	.575
Resin 101, 101EP, 103EP, 126, 202, 205, 400X65, 400X74L, 400X78	lb.	.38 /	.56
121	lb.	.41 /	.59
200X20	lb.	.42 /	.60
404HI	lb.	.43 /	.61
400X80	lb.	.46 /	.64
400X10	lb.	.44 /	.62
Krene, film	lb.	.56 /	.71
Sheeting	lb.	.55 /	.66
Marvinols	lb.	.38 /	.54
Opalon dry blends	lb.	.33 /	.72
Profile extrusion cmpds.	lb.	.37 /	.805
Resin 300	lb.	.38 /	.56
410	lb.	.41 /	.59
Wire cmpds.	lb.	.33 /	.77
Plastiflex, std.	lb.	.90 /	1.10
Novelty	lb.	1.15 /	1.50
Pliovic resins	lb.	.38 /	.40
Reynolon, 4000 series	lb.	1.55 /	2.30
Rolls, 1-mil	sq. yd.	.0625/	.11
Colors	sq. yd.	.0675/	.08
4-mil	sq. yd.	.215 /	.3125
Colors	sq. yd.	.2375/	.255
16-mil	sq. yd.	.81 /	1.19
Colors	sq. yd.	.86 /	.945
Satinflex	lb.	1.15 /	1.50

Vinylidine

Dow Latex 744-B	lb.	.30 /	.46
Saran formulation 115, black, nat.	lb.	.39 /	.52
Colors	lb.	.44 /	.69
720 nat.	lb.	.41 /	.54
Colors	lb.	.46 /	.71
747 nat.	lb.	.395 /	.525
761 nat.	lb.	.39 /	.52
Colors	lb.	.44 /	.69
820 nat.	lb.	.42 /	.55
Colors	lb.	.47 /	.60
Latices	lb.	.45 /	.61
Resin F 120	lb.	.58 /	.65

Plasticizers

Adipol 2EH, 10A, 810	lb.	.435 /	.465
BCA	lb.	.45 /	.475
ODY	lb.	.48 /	.51
XX	lb.	.435 /	.465
Barrett dibutyl phthalate	lb.	.30 /	.34
Dimethyl phthalate	lb.	.275 /	.306
Benzoflex 2-45	lb.	.26 /	.29
9-88	lb.	.32 /	.35
Cabflex DDA	lb.	.435 /	.515
DDP, Di-OP, DOP, ODP	lb.	.305 /	.385
Di-BA, Di-OA, DOA, ODA	lb.	.435 /	.515
Di-OZ	lb.	.48 /	.5575
Cabol 100	lb.	.02 /	.11
Chlorowax 40	lb.	.155 /	.165
70	lb.	.18 /	.19
70S	lb.	.21 /	.22
LV	lb.	.175 /	.185
Darex dibutyl phthalate	lb.	.30 /	.33
DIOP	lb.	.305 /	.355
DOP	lb.	.305 /	.335
Dinopol 235	lb.	.335 /	.365
IDO	lb.	.305 /	.335
MOP	lb.	.32 /	.35
Dow Plasticizer No. 5	lb.	.315 /	.54
Resin 276-V2,-V9	lb.	.265 /	.325
Drapex 3.2	lb.	.44 /	.49
Dutch Boy Plasticizer NL-A10 (DBP)	lb.	.30 /	.33
NL-A20 (DOP), NL-A30 (DIOP)	lb.	.305 /	.335
NL-C20 (DOS)	lb.	.61 /	.63
NL-F21	lb.	.395 /	.425
NL-F31	lb.	.44 /	.47
NL-F41	lb.	.48 /	.51
NL-A54	lb.	.295 /	.325
Elastex 10-P, 28-P	lb.	.305 /	.336
40-P	lb.	.27 /	.31
50-B	lb.	.25 /	.29
80-P	lb.	.295 /	.326
90-P	lb.	.305 /	.335
DCHP	lb.	.59 /	.61
Ethox	lb.	.43 /	.455
Flexol 2GB	lb.	.35 /	.3775
3G	lb.	.53 /	.55
3GH	lb.	.44 /	.46
4GO	lb.	.325 /	.355
8N8	lb.	.355 /	.385
10-10	lb.	.305 /	.335
77-G	lb.	.32 /	.35
426	lb.	.27 /	.30
810, 812, CC-55, DOP	lb.	.305 /	.335
A-26	lb.	.425 /	.455
B-400	lb.	.25 /	.28
R2H	lb.	.59 /	.595
TOF	lb.	.435 /	.465
TWS	lb.	.41 /	.4375
Flexricin P-4	lb.	.30	
P-6	lb.	.36	
P-8	lb.	.32	
Good-rite GP-261	lb.	.305 /	.460
GP-233	lb.	.435 /	.585
Harflex	lb.	.64 /	.84
Kapsol	lb.	.3225/	.3525
KP-23	lb.	.29 /	.32
-90	lb.	.45 /	.48
-140	lb.	.46 /	.485
-201	lb.	.5825/	.5925
-220	lb.	.31 /	.34
-555	lb.	.45 /	.475
Kronisol	lb.	.33 /	.355
Kronitex AA, I, K-3, MX	lb.	.33 /	.36
Marvinol decylbutyl phthalate	lb.	.27 /	.30
Dibutyl phthalate	lb.	.30 /	.33
Sebacate	lb.	.665 /	.69
Diisooctyl adipate	lb.	.435 /	.465
Phthalate	lb.	.305 /	.335
Dinonyl adipate	lb.	.445 /	.475
Dioctyl adipate	lb.	.435 /	.465
Phthalate	lb.	.305 /	.365
Sebacate	lb.	.615 /	.64
Epoxy plasticizer	lb.	.345 /	.37
Isooctyl decyl phthalate	lb.	.305 /	.335
Tricresyl phosphate	lb.	.33 /	.36
Methox	lb.	.385 /	.41
Ohio-Apex butyl oleate	lb.	.2325/	.26
Stearate	lb.	.22 /	.25
Diallyl phthalate	lb.	.4975/	.5225
Dicapryl phthalate	lb.	.295 /	.325
Di-Carbitol phthalate	lb.	.40 /	.425
Dioctyl phthalate	lb.	.305 /	.335
D.I.O.P.	lb.	.305 /	.335
Tributyl phosphate	lb.	.50 /	.53
Ohopex Q-10	lb.	.295 /	.325
R-9	lb.	.3525/	.3775
Pfizer acetyl tributyl citrate, tech.	lb.	.32 /	.57
Acetyl triethyl citrate, tech.	lb.	.36 /	.57
Triethyl citrate	lb.	.4575/	.58
Plasticizer 120	lb.	.44 /	.49
Plastoflex #3	lb.	.52 /	.57
#520	lb.	.36 /	.435
D B E	lb.	.50 /	.55
MGB	lb.	.32 /	.40
SP-2	lb.	.43 /	.48

VS	lb.	.40 /	.4775
Plastolein 9050 DHZ	lb.	.52 /	.555
9055 DGP	lb.	.28 /	.315
9057 DIOZ	lb.	.48 /	.515
9058 DOZ	lb.	.48 /	.515
9250 THFO	lb.	.3425/	.3775
9715 Polymeric	lb.	.37 /	.405
9720 Polymeric	lb.	.37 /	.405
PX-104	lb.	.30 /	.39
-108, -118, -138	lb.	.305 /	.395
-114	lb.	.27 /	.36
-208, -238	lb.	.435 /	.525
-209	lb.	.445 /	.535
-404	lb.	.665 /	.75
-438	lb.	.615 /	.70
-809	lb.	.345 /	.43
-917	lb.	.33 /	.42
Pycal 40	lb.	.3875/	.4375
60	lb.	.60 /	.635
62	lb.	.80 /	.835
94	lb.	.3275/	.3775
140	lb.	.35 /	.40
170	lb.	.275 /	.325
194	lb.	.2775/	.3275
Staflex AX	lb.	.43	
BR	lb.	.26 /	.29
CP	lb.	.28 /	.31
DBES, DOS	lb.	.61 /	.635
DIOA, ODA	lb.	.435 /	.465
DIOP, DOP, MP	lb.	.305 /	.335
DOZ	lb.	.48 /	.5075
IXA	lb.	.32 /	.35
KA	lb.	.36 /	.3875
KD	lb.	.44 /	.4675
Witcizer #100	lb.	.26 /	.27
#101	lb.	.31 /	.32
#200	lb.	.195 /	.205
#201	lb.	.235 /	.245
#300	lb.	.30 /	.33
#312, 313	lb.	.305 /	.33
#412	lb.	.435 /	.465

Solvents

Enjay acetone	gal.	.075 /	.105
Diisobutylene	gal.	.08 /	.11
Isopropyl acetate	gal.	.10 /	.13
Methyl ethyl ketone	gal.	.11 /	.14
Secondary butyl acetone	gal.	.1075/	.1375
Butyl alcohol	gal.	.11 /	.14
Petrohol 91%	gal.	.35 /	.55
95%	gal.	.37 /	.57
99%	gal.	.39 /	.59

Stabilizers

Advastab #3, #52, OM-10	lb.	1.90 /	2.00
17-M	lb.	3.00 /	3.25
#21	lb.	1.00 /	1.18
#21 new, #143, E-6-B	lb.	.80 /	.90
#42	lb.	.83 /	.93
89-X	lb.	.75 /	.80
BA-13-P, BC-105	lb.	.75 /	.85
BC-12	lb.	.87 /	.95
C-77	lb.	.85 /	.95
CH-14, -20	lb.	.63 /	.70
E-49	lb.	.60 /	.65
E-98	lb.	.55 /	.65
JCX	lb.	.62 /	.68
L paste	lb.	.65 /	.70
OM-18	lb.	3.10 /	3.35
P-1835, T-72	lb.	3.20 /	3.35
PS-38, ZN-9	lb.	.50 /	.65
SN	lb.	.47 /	.53
V-1-N	lb.	.40 /	.48
VL-3	lb.	.95 /	1.05
Barca 10	lb.	.75 /	.80
Baker barium ricinoleate	lb.	.70	
Calcium ricinoleate	lb.	.55	
Dutch Boy Barinac	lb.	.70	
Calstar	lb.	.36	
CS-137	lb.	1.25	
DS-207	lb.	.54 /	.555
Dyphos	lb.	.57 /	.585
50A	lb.	.335	
Dythal	lb.	.395 /	.41
L-26	lb.	.50	
Leadstar	lb.	.39	
Normal lead maleate	lb.	.4475	
Normasal	lb.	.46	
Pearlescent pigment	lb.	1.00	
Plumb-O-Sil-A	lb.	.2975	
-B	lb.	.3125/	.36
-C	lb.	.3425/	.375
Tribase	lb.	.265 /	.28
-E	lb.	.215	
Trimal	lb.	.435	
Harshaw 1-V-3	lb.	.43	
1-V-4	lb.	.68	
1-V-7	lb.	.66 /	.71
2-V-4	lb.	.85 /	.90
2-V-7	lb.	1.10 /	1.15
2-V-8	lb.	1.30	
2-V-400	lb.	.80 /	.85
5-V-1	lb.	.41	
5-V-22	lb.	.49	
7-V-1	lb.	.90 /	.95
7-V-2	lb.	.95 /	1.00
7-V-4	lb.	1.18 /	1.23
8-V-1	lb.	1.10 /	1.15
8-V-5	lb.	.80 /	.85
8-V-100	lb.	.84 /	.89
9-V-1	lb.	.76 /	.81
12-V-5	lb.	.75	
22-V-1	lb.	1.28	
24-V-1	lb.	1.28 /	1.33
28-V-2	lb.	1.18	
128-V-5	lb.	.86	
281-V-4	lb.	.90	
Metasap 613-A	lb.	.69	
613-B	lb.	.84	
613-C	lb.	1.06	
621	lb.	.88	
624	lb.	.75	
Cadmium stearate	lb.	1.40 /	1.44
Fused stearates, calcium 602-A	lb.	.25 /	.30
Dibasic lead stearate	lb.	.56	
Lead 611	lb.	.32 /	.37
Lead stearate	lb.	.39 /	.44
Nuostable V-1	lb.	.54 /	.59
V-2	lb.	.39 /	.44
V-10	lb.	.70 /	.75
V-20	lb.	1.30 /	1.35
V-21	lb.	1.29 /	1.34
V-30	lb.	.90 /	.95
V-31	lb.	.80 /	.85
V-40	lb.	1.18 /	1.23
V-42	lb.	.65 /	.70
V-43	lb.	.75 /	.80
V-44	lb.	.90 /	.95
V-45	lb.	1.10 /	1.15
V-50	lb.	.49 /	.54
V-60	lb.	.37 /	.42
V-70	lb.	.68 /	.73
V-80	lb.	2.80 /	2.85
V-81	lb.	2.90 /	2.95
Stabilizer #3, 52	lb.	1.90 /	2.00
17-M	lb.	3.00 /	3.25
#42	lb.	.83 /	.93
89-X	lb.	.75 /	.80
#143	lb.	.80 /	.90
A-5	lb.	1.25	
BC-12	lb.	.87 /	.95
BC-105	lb.	.75 /	.85
C-2	lb.	1.65	
C-77	lb.	.85 /	.95
CH-14	lb.	.63 /	.70
CH-20	lb.	.63 /	.65
D-22	lb.	1.99 /	2.05
E-6-B	lb.	.80 /	.90
E-49	lb.	.60 /	.65
E-98	lb.	.55 /	.65
JCX	lb.	.62 /	.68
L-Paste	lb.	.60 /	.65
Mark E	lb.	.72 /	.85
M	lb.	.73 /	.83
PL	lb.	.74 /	.84
TT	lb.	.77 /	.91
V	lb.	.91 /	1.04
X	lb.	2.50 /	2.75
XI	lb.	.87 /	1.01
XV	lb.	.92 /	1.01
XX	lb.	.63 /	.74
OM-10	lb.	1.90 /	2.00
-18	lb.	3.10 /	3.35
P-1835	lb.	3.20 /	3.35
PS-38	lb.	.50 /	.65
SN	lb.	.47 /	.53
T-72	lb.	3.20 /	3.35
V-I-N	lb.	.40 /	.48
VL-3	lb.	.95 /	1.05
Staflex QMXA	lb.	.70	
50% in DOP	lb.	.52	
OV	lb.	1.00 /	1.20
Stayrite #10	lb.	.33 /	.37
#15	lb.	.54 /	.57
#20	lb.	.38 /	.42
#22	lb.	1.32 /	1.34
#25	lb.	.36 /	.40
#70, 75, 80, 90	lb.	.69 /	.70
#229	lb.	.47 /	.50
P-10	lb.	.40 /	.44
Thermolite No. 12	lb.	2.00 /	2.26
13	lb.	3.10 /	3.78
15	lb.	4.13	
17, 99	lb.	3.00	
20	lb.	3.25	
31	lb.	3.05 /	3.25
Vanstay HT	lb.	.90 /	.92
L	lb.	.33 /	.35
R	lb.	.88 /	.90
S	lb.	.63 /	.65

Wetting Agents

Advawet X-212	lb.	.50 /	.55
Poly-lube No. 4	qt.	1.45 /	1.94